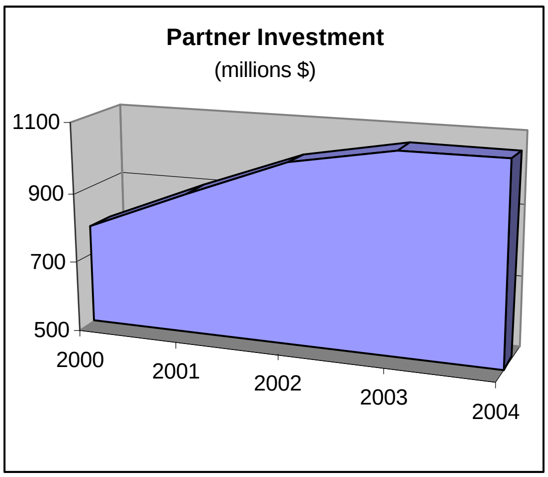
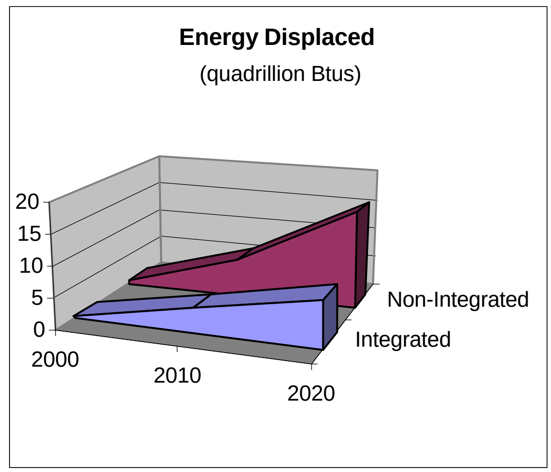
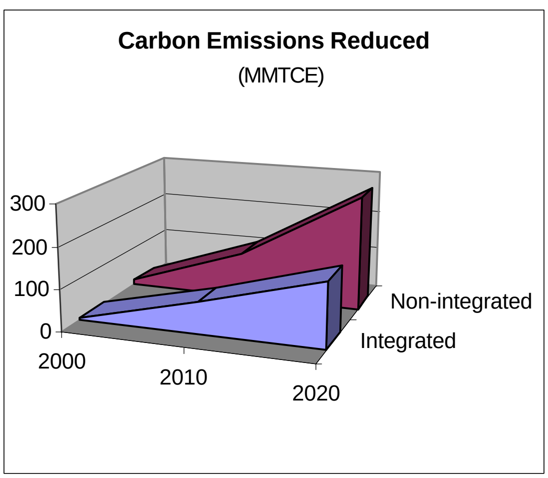
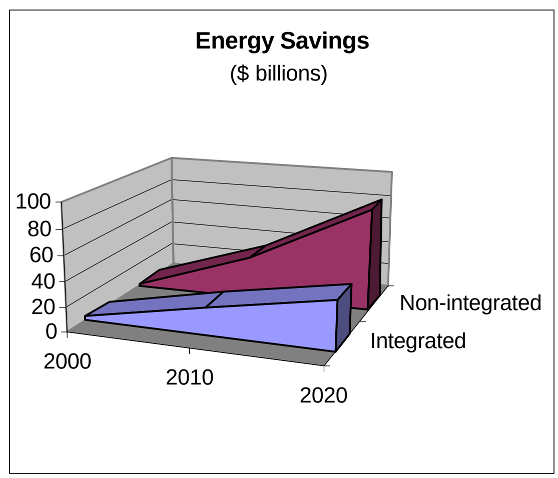
Milestones and Projected Benefits of Federal Energy Efficiency and Renewable Energy Programs

FY 2000 – FY 2020









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By

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Introduction

A confluence of two forces is increasing the need for information on the benefits of federal energy efficiency and renewable energy programs – performance-based management and global climate change. The performance-based management, or performance measurement, movement responds to concerns over limited resources and a lack of agency accountability by requiring government agencies to provide performance information on their programs. This world-wide movement has manifested itself in the United States at the federal level through a series of laws, the most prominent of which is the Government Performance and Results Act of 1993 (GPRA), which requires federal agencies to annually plan the performance of their programs and to subsequently measure progress against this plan.

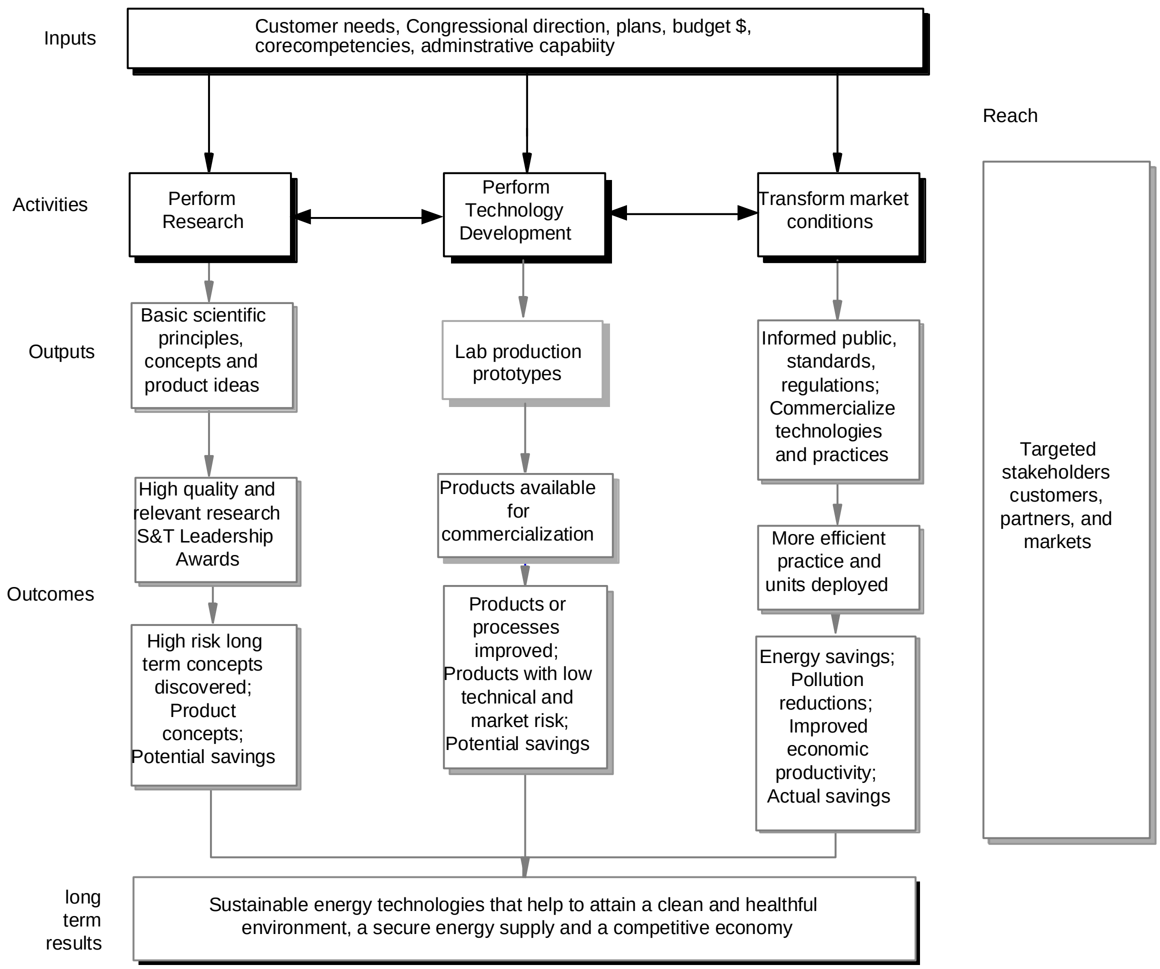
At the same time, there have been increasing pressures to reduce greenhouse gas emissions, which adversely affect the earth's climate. In the First UN Framework Convention on Climate Change the US committed to reducing greenhouse gas emissions to 1990 levels by 2000. The more recent Kyoto protocol suggests that the U.S. reduce carbon emissions to 7% below 1990 levels by 2012 using the average emission levels over the five year budget period 2008-2012.

The US Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) has a role in responding to both of these movements. As a federal agency it is required to comply with GPRA, provisions of which went into effect in Fiscal Year 1999. As an agency designed to increase the development and use of energy efficient and renewable energy technologies, which reduce greenhouse gas emissions, EERE also plays a strong role in meeting climate change goals.

This report identifies the annual process by which EERE collects data for use in GPRA and climate change analyses and reports the data collected for Fiscal Year 2000. The current data collection effort has its roots EERE's 1993 Managing for Results activity. The purpose of Managing for Results was to collect benefit and cost information on EERE's programs to assist in funding decisions. In 1994 Managing for Results was renamed Quality Metrics. In 1995 near term (five year) performance measures (PM) were added to the FY1997 data collection to support the long term quality metrics and the process renamed the Quality Metrics/Performance Measures (QM/PM) data call. In 1997 the FY1999 data call attempted to improve the links between near-term performance measures and long-term quality metrics by requesting the technology and market penetration assumptions used in calculating long-term benefit estimates. The FY1999 data was also the first used to meet GPRA requirements and was therefore renamed the GPRA Data Call.

Understanding the EERE's data collection process first requires a general familiarity with EERE. The logic behind how EERE turns resources into milestones (outputs) and benefits (outcomes) is presented in Figure 1. EERE collaborates with scientists, consumers, suppliers, industry officials, and other government organizations to perform research, develop new and improved products and processes, and provide policy, standards, technical tools and information that will accelerate and expand the adoption of energy efficient and renewable energy technologies. The adoption of these technologies will result in energy savings, increased use of alternative energy sources such as wind and solar, which means a cleaner, healthier environment, and less dependence on imported oil. The office is structured around the end-use sectors for which its technologies are developed: buildings, industry, and transportation, as well as the power sector and the federal government.

Figure 1: Sample EE Logic Chart



Data Collection, Review and Analysis Process

The annual process for obtaining projected benefits and performance measures occurs over approximately a nine month period, starting in April and ending in January. In April EERE's Office of Budget Planning and Customer Service (OBPCS) begins development of a data collection packet or survey instrument. A draft instrument is distributed to EERE's five sectors for review, with comments incorporated into a final instrument that is distributed in June.[1] Sectors have about three months to submit their initial response to OBPCS. After initial responses are received, about one quarter of the planning unit responses are reviewed by external experts from October through December.[2] Planning unit responses are also used in an integrated analysis that accounts for the interaction effects across sector programs. The integrated analysis is completed in early December. Final projected benefits and performance measures are then placed in the EERE budget request and help form EERE's portion of the Department's Performance Plan and Performance Agreement with the President[3]. The survey instrument, external review, and integrated analysis for FY2000 are described below.

Survey Instrument

The survey instrument developed for Fiscal Year 2000 parallels the EERE logic chart by requesting the following information:

- 5 Year Goal Statement
- Past Accomplishments: milestones achieved in FY97-98 and cost to EERE
- Inputs: projected resources
- Outputs: near-term milestones
- Outcomes: projected energy, environmental and financial impacts
- Assumptions: technology characteristic, market penetration, and other

5 Year Goal Statement

The 5-year goal statement is a brief description of the results the planning unit expects to achieve and how it intends to achieve them. This goal provides important context for annual progress commitments, particularly for persons not familiar with EERE programs. The goal is measurable, quantitative where possible, and linked with annual progress goals.

Past Accomplishments

The accomplishments section requests FY1997 and FY1998 levels of performance for the goals and impact estimates provided in the remainder of the data call: resources received, milestones accomplished, as well as energy, financial and environmental impacts.

[1] See Appendix A for a copy of the FY 2000 survey instrument.
[2] See Appendix B for a copy of ADL's review report.
[3] See Appendix C for a copy of planning unit responses and sector totals (reflecting changes made after ADL review)

Projected Resources

Resources significantly impact the ability of planning units to achieve their goals. Therefore, information is requested about the level of resources used in estimating the planning unit's milestones and impacts. This includes funding estimates for FY1999 through FY2004, the percentage of funding allotted to research, development, and deployment, the level of partner investment in the planning unit (both financial and non-financial), and the number of partners with whom the planning unit is working.

Near-term Milestones

Milestones for the next five years are also provided along with an estimated cost to EERE for achieving each milestone. Milestones are divided into one of three categories, based on the assumption they are designed to influence – technology characteristics, market penetration, or other assumptions. These assumptions are used in estimating outcome metrics such as energy displaced, energy saved, and emissions reduced. For instance, a planning unit may have a series of technology characteristic milestones that are designed to improve the efficiency of an energy technology. This higher efficiency is subsequently used as an assumption in calculating the energy displaced for the technology. Similarly, a planning unit may have market penetration milestones designed to impact market penetration assumptions.

Projected energy, environmental and financial impacts

The energy, environmental and financial impacts of planning unit activities are captured by a variety of metrics, shown in Table 2 below.

Table 2: Energy, environmental and financial metrics

Energy	**Environmental**	**Financial**
Total Primary Energy Displaced	Carbon Emissions Displaced	Energy Costs or Savings
Direct Electricity Displaced	CO Displaced	Non-Energy Costs or Savings
Direct Natural Gas Displaced	Other Greenhouse Emissions Displaced	
Direct Petroleum Displaced	SO2 Displaced	
Direct Coal Displaced	NOx Displaced	
	Particulates Displaced	
	VOCs Displaced	
	HCs Displaced	
	Other Environmental Benefits	

Assumptions

Assumption used in calculating energy, environmental and financial impacts are requested. At a minimum, these should include market penetration levels, technology performance levels, and technology cost. The Energy Information Administration's Annual Energy Outlook 1998 served as a baseline scenario for energy prices; residential, commercial, industrial, transportation, and utility sector technology projections; and energy consumption by industry.

The survey instrument was distributed in June 1998 to EERE's five sectors – Office of Building, State and Community Programs (BTS), Office of Industrial Technologies (OIT), Office of Power Technologies (OPT), Office of Transportation Technologies (OTT), and the Federal Energy Management Program (FEMP). Responses were received from 41 planning units. Responses were not provided for two new planning units, OIT's Agriculture and Mining Visions.

External Reviews

For the past four years EERE has had external experts review a portion of the planning unit responses. Nine planning units were selected for the FY2000 review, based on whether they had large expected energy savings, had not been previously reviewed, were impacted by significant changes from last year's analysis (e.g., new initiatives), and had high visibility[4]. The nine planning units reviewed for FY2000 include:

Office of Building Technology and State/Community Programs (BTS)
- Commercial Buildings Integration
- Residential Buildings Integration

Office of Industrial Technologies (OIT)
- CFCC's (part of the Advanced Materials planning unit)
- Glass Vision
- Metals Casting Vision

Office of Power Technologies (OPT)
- High Temperature Superconductivity
- Hydropower
- Photovoltaics

Office of Transportation Technology (OTT)
- Advanced Automotive Technologies

ADL experts worked with DOE staff to review the estimates and assumptions for each of the planning units. The external review is an interactive, iterative process between the individual planning unit managers and ADL experts, in each case leading to a consensus regarding the final submissions. ADL evaluated two primary metrics:

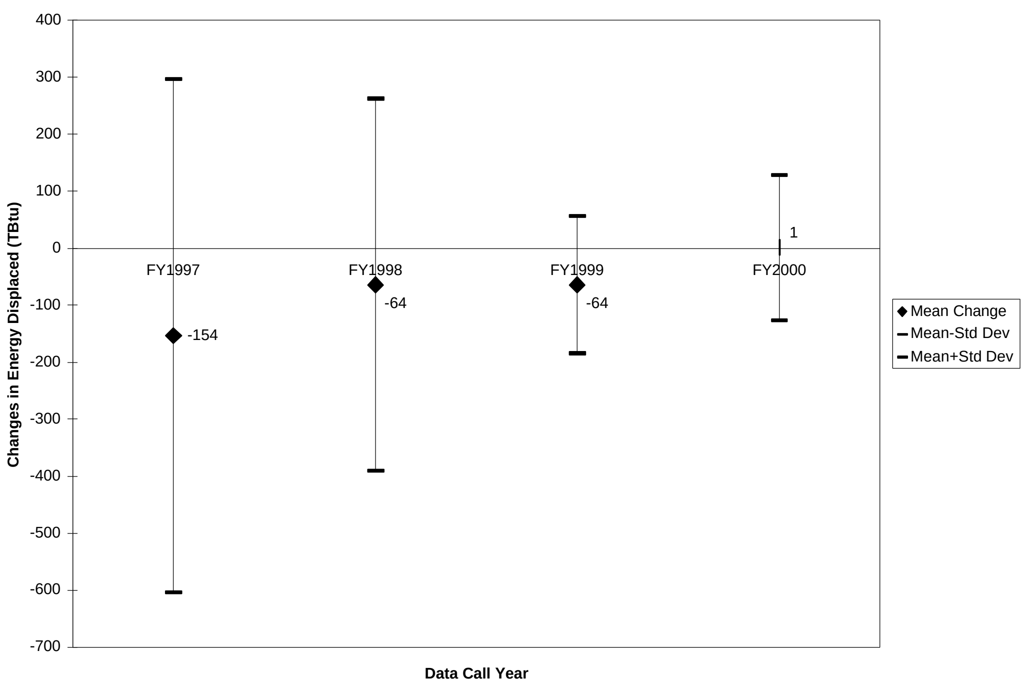
- The energy and emission savings of each technology projected for the years 2000 through 2020, which depend on estimates of market penetration, cost, and performance assumptions for each technology.
- The performance measurements of each planning unit, which include near-term goals and milestones for the next five years designed to achieve the market penetration, cost, and performance objectives underlying the energy savings metrics.

[4] See the Arthur D. Little report contained in Appendix B.

Sandia National Laboratories contributed to ADL's review by providing comments related to planning unit milestones and their links to longer term impacts and the 5 year goal statement. Comments were also provided on milestone measurability, ability to achieve the milestones, and links to other public commitments.

The discussions between ADL and the sectors within EERE have resulted in agreement on revised program impact estimates. Seven of the nine planning units revised their energy and emissions figures as a result of the FY 2000 ADL review, and the other two made revisions of their own accord. A comparison of these revisions against those made in the previous three years shows that revisions are becoming smaller, likely indicating an improvement in EERE's estimates. Figure 2 shows that the average change to planning unit energy displacement figures after the external reviews have declined from -154 TBtu in FY 1997 (i.e., the estimates were reduced by an average of 154 TBtu) to -64 TBtu in FY 1998 and 1999, to 1 TBtu in FY 2000. At the same time, the standard deviation of changes has narrowed from 450 TBtu in FY 1997 to 128 TBtu in FY 2000.

Figure 2: Changes in Energy Displacement After External Reviews FY1997-2000



Integrated Analysis[5]

Once initial impact estimates were submitted by each sector, an "integrated set" of impact estimates were developed. The purpose of this assessment is to analyze EE's programs in a consistent economic framework and to account for the interactive effects among the various programs. Sector estimates of the savings for their programs cannot be simply summed to create a value for all of EE. There will be feedback and interactive effects resulting from (1) changes in

[5] The Integrated Analysis description draws heavily from OnLocation's Integrated Analysis report, which is contained in Appendix D.

energy prices resulting from lower energy consumption and (2) the interaction between programs affecting the mix of generation sources and those affecting the demand for electricity.

The National Energy Modeling System (NEMS) was used this year for the first time as the integrated model. The Annual Energy Outlook 1998 (AEO98) version was used as the starting point. Several changes were then made to the model to enhance its ability to represent the EE programs. The most significant change was the addition of an endogenous building shell efficiency component. In addition, several of the modules were altered to allow for technology characteristics and other parameters to be specified by the user. The modified version of the model is referred to here as NEMS*.

The No EE Case. The baseline forecast, called the No EE Case, is a projection meant to represent the future U.S. energy system without the effect of continued EE programs. The idea is to remove any effects of EE programs that are already included in the AEO98 Reference Case in order to avoid double counting energy consumption reductions. As recommended by the various EE sector offices, the following modifications were made for the No EE Case. For the transportation sector, it was assumed that no alternative fuel vehicles would be purchased except those mandated in California. Similarly, in the utility sector, it was assumed that there would be no new renewable capacity constructed except as part of state set-asides as represented in the AEO. As will be discussed in the buildings section, the No EE Case includes the modified shell efficiency structure and assumes that part of the shell efficiency improvement in the Residential sector in the AEO98 is attributable to EE programs. No changes were made to the industrial sector for the No EE Case. See the Integrated Modeling for GPRA 2000 report in Appendix D for the No EE Case projected energy consumption by sector and fuel.

Representation of EE Programs. After the No EE Case was established, the EE programs were represented in the various NEMS* modules. Each sector was treated separately to derive estimated energy savings without the interaction of the other sectors' programs[6]. Inputs for the programs were received from the sector offices and their contractors. To the maximum extent possible, programs were represented through their impacts on technology characteristics and allowing NEMS* to project the market penetration and savings resulting from their development. In some cases, where the model had insufficient representation, projections were based on the program office penetration estimates and NEMS* was simply used as an accounting tool. A major exception is the treatment of the industrial sector. The OIT programs and technologies are very specialized and beyond the capability of the model to represent. For this sector estimated energy savings were simply input.

Energy savings were estimated at the planning unit level for each sector, except for industry. In this step, the primary savings for electricity were computed using the heat rates supplied in the GPRA assumptions. The use of the GRPA specified heat rate makes the savings more directly comparable to the sectors' estimates than they were last year when the electricity savings were those calculated by the model. This year the integration with electricity is kept separate and is introduced as part of the integration effect. Preliminary comparison tables were shared with EE, and minor modeling adjustments were made based on their comments.

[6] The modeling of the individual demand models was done using PC stand-alone versions of the module that speed the run time and facilitate data changes.

The full NEMS* model was then run for each of the sector office programs individually. In these scenarios the energy savings include the effect that a single sector's programs have on fuel consumption in other sectors. For example, reductions in energy usage generally lead to lower energy prices, which may stimulate additional demand, both in the sector that is being analyzed and in all other sectors. The primary energy associated with reduced electricity generation is calculated endogenously within the electricity module. In addition, reductions in oil and gas use affect the energy required for petroleum refining, lease and plant fuel, and pipeline gas consumption.

Next, the model was run with all the programs in all the sectors to derive the Full EE Case. The total primary energy savings (fossil savings because renewables are not included) and carbon savings were then allocated to the individual sectors. Because the total savings were not equal to the sum of the individual sectors, they were allocated to the sectors based on the single-sector integrated savings estimates.

Projected Resources FY2000-2004

Each planning unit was asked to provide projected resources for FY2000-2004 including DOE funding, percentage of funding targeted for research, development or deployment (R,D&D), the number of partners, partner financial investment, and partner non-financial investment. Planning unit responses and sector totals are provided in Appendix C. A sector breakdown of EERE's FY 2000 budget request is provided in Figure 3. This information is taken from EERE's FY 2000 budget request because budget information provided in the data call was incomplete. The distribution of budget dollars across R,D&D categories for FY 2000 is provided in Figure 4. Definitions for research, development and deployment are contained in the data call provided in Appendix A. The breakdown provided in Figure 4 is estimated to remain relatively stable through 2004.

Figure 3[7]

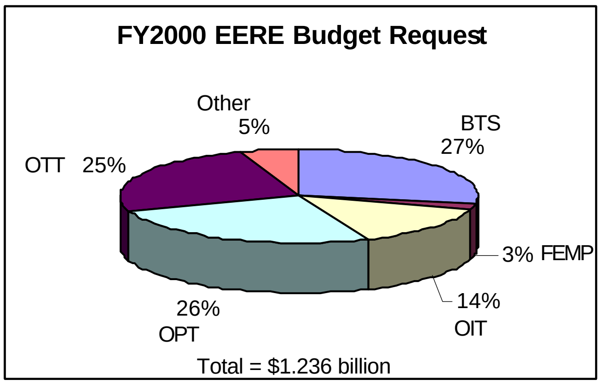
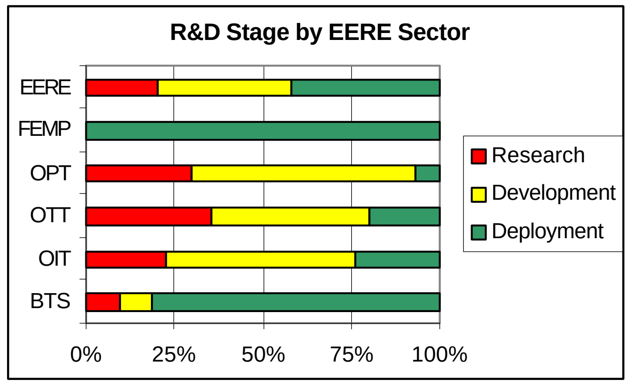
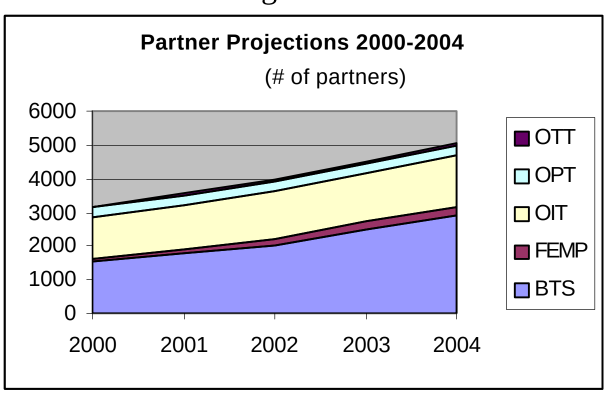


Figure 4[8]



EERE works with numerous partners as it pursues its mission. Partners are an important measure of the relevance of EERE's work to the private sector. It is estimated that EERE will work with over 3100 partners in FY 2000 – a figure that is expected to grow to about 5000 in 2004 (see Figure 5).

Figure 5



[7] Sector percentages are based on data in EERE's FY 2000 budget request.
[8] R,D&D percentages are based on sector responses to the FY 2000 data call. Some planning unit data are missing.

Another measure of the private sector's interest in EERE's programs is the amount of money partners are willing to invest in their partnerships with EERE. This second measure is important because in some areas EERE is working with a handful of partners, but the partners are making large investments. Partners typically contribute financial and/or non-financial resources. Financial resources represent the amount of money partners are contributing to co-fund or co-deliver an EERE product or service, including related planning activities. Non-financial resources represent the dollar equivalent of equipment, staff, or facilities devoted to the partnership. It is estimated that EERE partners will contribute over $784 million in financial resources in FY 2000 and $350 million in non-financial resources. These figures are expected to grow to $1,066 million and $457 million, respectively, in 2004. (See Figures 6 and 7)

Figure 6

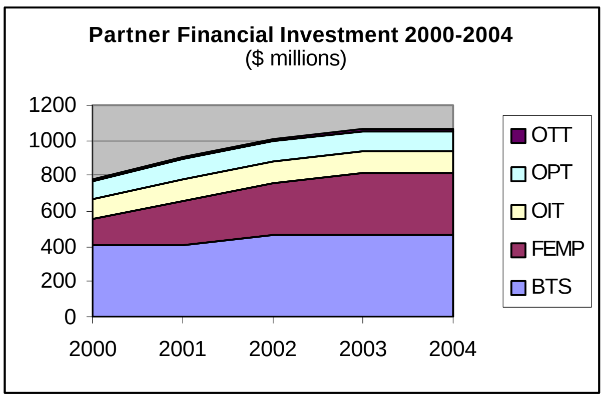
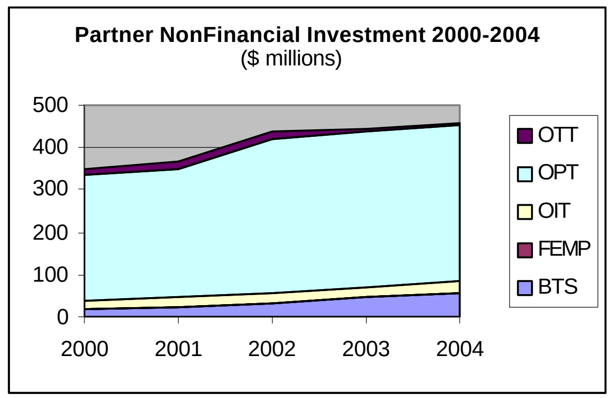


Figure 7



Major Milestones 2000-2004

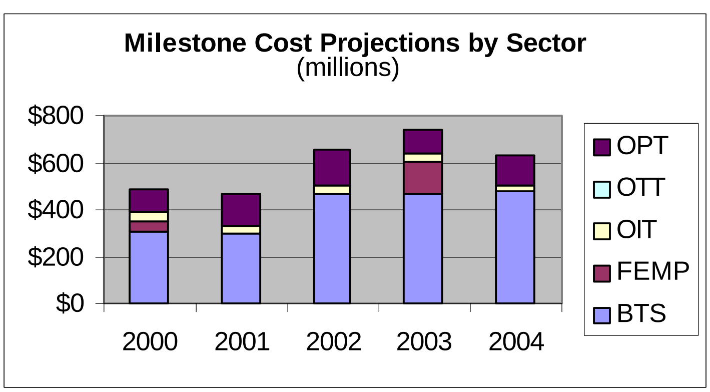
To establish a bridge between EERE resources and long term impacts, planning units were asked to provide major near-term milestones for 1997-2004 and an estimated cost to EERE for achieving each milestone. Virtually all planning units provided milestones, though not all years were covered and estimated costs were sometimes absent. A listing of the most costly FY 2000 milestones for each sector are provided in Table 2.

Table 2: Major FY 2000 Milestones by Sector

Sector	Milestone	Estimated Cost
BTS	Weatherize additional 180,100 homes (78,200 with direct DOE funds, 101,900 with matching funds)	$154.1 million
FEMP	Reduce site energy intensity (Btu/gross square foot) by 20% relative to 1985 baseline levels in federal facilities	$ 38.9 million
OIT	Complete solicitation to industry to conduct R&D responsive to Steel Technology Roadmap	$ 10.0 million
OPT	Complete two system development projects and complete Phase II of Small Modular Systems Initiative (Biomass Power R&D)	$ 12.0 million
OTT	Three domestic automakers to incorporate the most promising PNGV technologies in concept vehicles with up to three times average fuel economy of 1993 Taurus, Lumina and Concorde models	N/A

The intention behind collecting milestone costs is to link milestones to the budget, with a planning unit's estimated milestone costs approximating its budget. Milestone costs are also a means of identifying areas where EERE is ahead or behind schedule. Of the 505 milestones identified for 2000-2004, 343 (68%) identified costs. The $483 million in milestone costs for FY2000 represent about 40% of EERE's budget request for that year and climbs to as high as 60% in 2003. This indicates that additional milestones need to be identified or that current cost estimates are too low. Figure 8 shows milestone cost projections by sector for FY2000-2004.

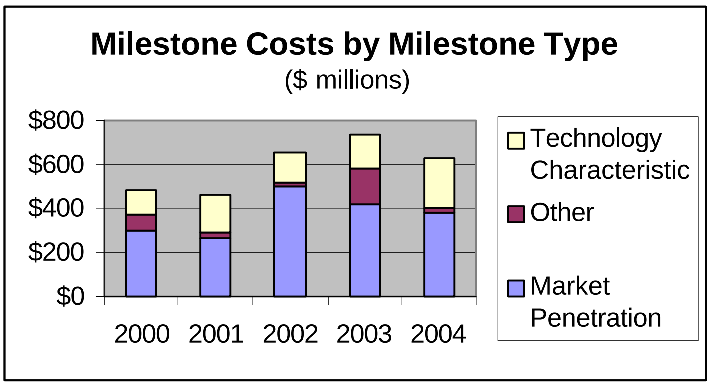
Figure 8[9]



[9] Cost information missing for some planning units.

Milestones were classified according to the assumptions they were intended to impact: technology characteristics, market penetration, or other. The intention behind this classification is to clarify the link between milestones and impacts. However, the costs of milestones in each category also serves as a check against the R,D&D resource breakdown. A planning unit with 100% of its resources in deployment should not have any technology characteristic milestones. Rather, virtually all of its milestones should be classified as market penetration milestones (some milestones may be classified as "other".) At the present time, such a comparison at the EERE level is not possible due to missing data for milestones, milestone costs and R,D&D resources. Figure 9 provides information on milestone costs by milestone type for the milestones identifying costs .

Figure 9[10]



[10] Cost information missing for some planning units.

Projected Benefits 2000-2020

Planning units were asked to identify the impacts of their programs for the years 2000-2005, 2010, 2015, and 2020. Program impact or benefit metrics were divided into three areas reflecting the benefits of EERE programs – energy, environmental, and financial metrics. A list of the metrics associated with each area is contained in Table 1. Definitions for each may be found in the data call instrument provided in Appendix A.

All planning units provided impact data, reports of which are contained in Appendix C. Sector and EERE level impact data are derived from the planning unit data and presented as ranges. Upper ranges are (non-integrated) aggregations of planning unit analyses while lower ranges are derived from the integrated analysis described earlier. Program benefits are typically lower in the integrated analysis than the non-integrated analyses because inter- and intra-sector double-counting is eliminated, and energy efficiency gains reduce the amount of new electricity generation likely to be installed. In some instances the non-integrated totals are lower due to revisions by planning units after the integrated analysis was performed. Integrated and non-integrated totals placed in the FY 2000 Budget (Interior) are provided in Table 3. Graphs for the integrated totals depicted in Figures 10, 11 and 12. Table 4 provides a planning unit breakdown of the non-integrated numbers. Some minor differences between Tables 3 and 4 may be found due to changes that were made after the budget was submitted. Graph 13 shows the impact the programs will have relative to projections under a "No EE" case – where the effects of EERE's programs are removed from AEO98 projections.

Three items need to be kept in mind when reviewing the impact estimates. First, estimates assume all program goals are met. Second, estimates represent annual benefits, not cumulative ones. Third, estimates are designed to capture the benefits of current and future EERE programs, not past ones. Program activities before FY 2000 resulting in energy, emission, or financial benefits in or after FY 2000 are excluded.[11] As a result, benefit estimates within the FY 2000 data call increase with time as technologies creating the benefits are diffused throughout the market. This is apparent in Figures 10-12. In future data calls estimates for the same year will likely decrease because of the shorter time frame in which a technology has to diffuse.

[11] The indirect benefits of earlier programs may be included however. For instance, R&D programs that build upon past R&D or deployment programs that learn from past deployment efforts.

Figure 10. It is estimated that if EERE programs meet all of their goals it will result in the displacement of 304 trillion Btu (TBtu) in 2000, 3917 TBtu in 2010, and 7547 TBtu in 2020 (integrated estimates).

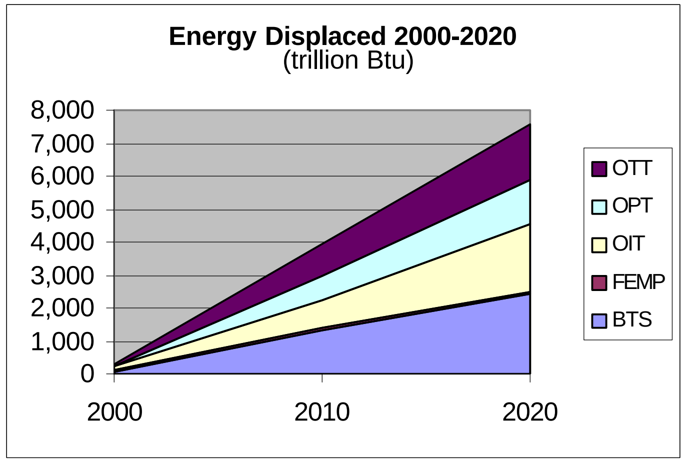


Figure 11. The displacement of energy is estimated to result in the reduction of 5.7 million metric tons of carbon equivalent (MMTCE) in 2000, 75.2 MMTCE in 2010, and 156.4 MMTCE in 2020 (integrated estimates).

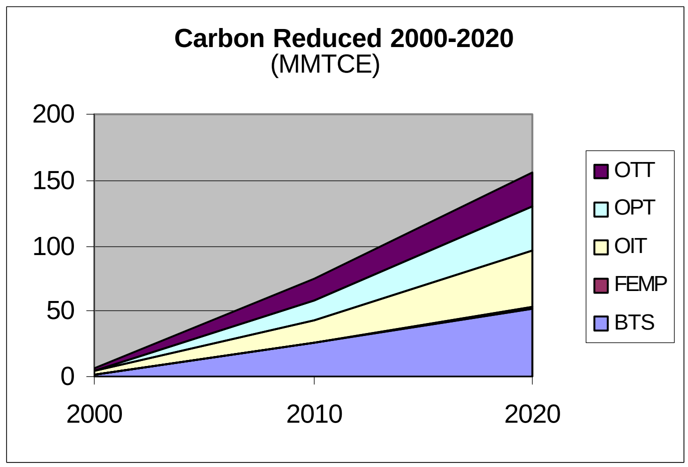
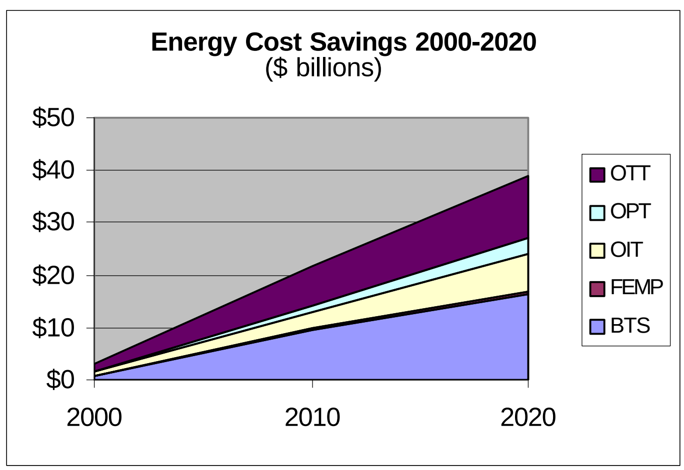


Figure 12. The displacement of energy will also result in energy savings of $3.20 billion in 2000, $21.8 billion in 2010, and $39.0 billion in 2020 (integrated estimates).



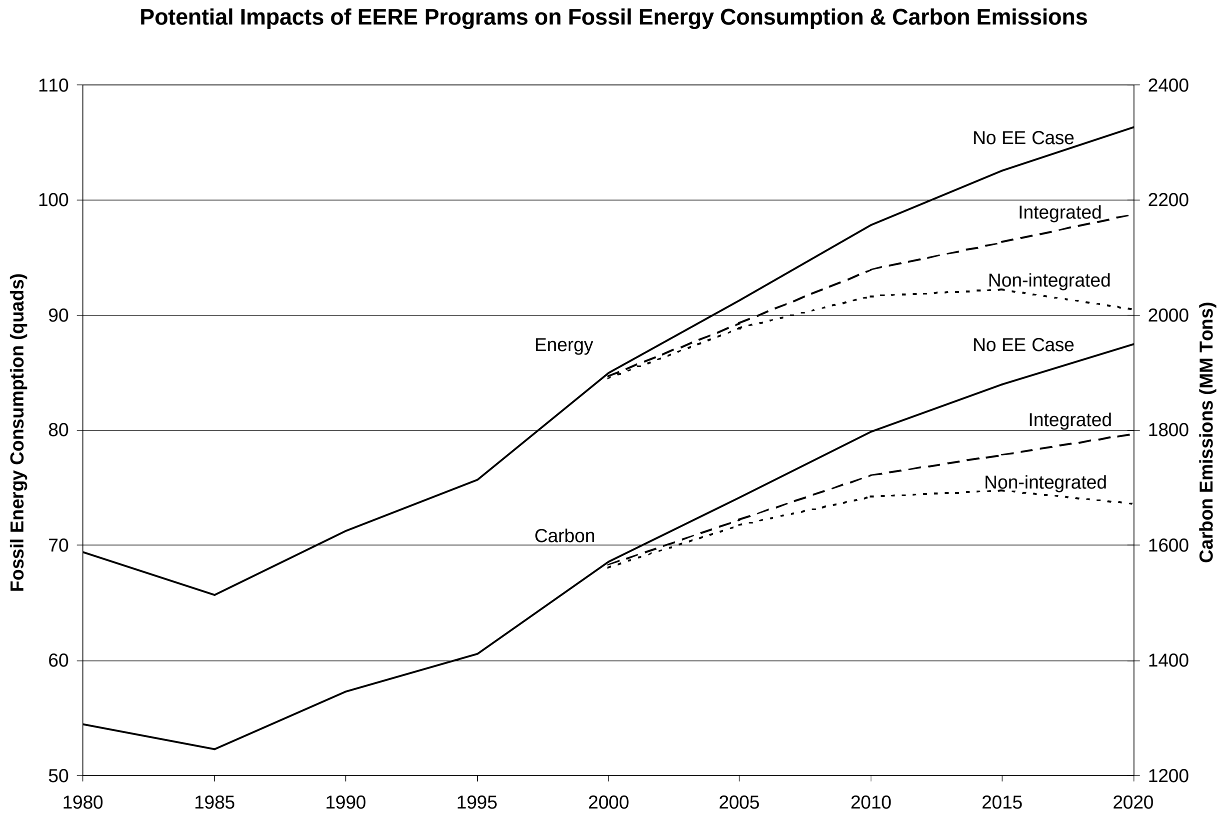


Figure 13. By 2020, EERE's programs could reduce *total* fossil energy consumption by 7-15% and reduce *total* carbon emissions by 8-14% compared to the "No-EE" case, where the effects of EERE's programs are removed from AEO98 projections. Projected *growth* in fossil energy consumption could be reduced by 35-74% by 2020. Projected *growth* in carbon emissions could be reduced by 41-74% by 2020.

Table 3

Office of Energy Efficiency and Renewable Energy **Energy Efficiency Programs Projected Benefits by Sector through the Year 2020**									
	Total Primary Energy Displaced (Quadrillion BTUs)			Energy Cost Savings* ($ billions)			Carbon Reductions (million metric tons)		
	2000	2010	2020	2000	2010	2020	2000	2010	2020
Transportation Sector *(oil savings in quads)*	0.01-0.07 (*.08-.13*)	1.0-1.2 (*1.6-1.8*)	1.7-3.0 (*3.0-3.8*)	0.2-2.3	7.8-9.9	12.1-22.1	0.5-1.5	17.0-24.8	26.5-59.8
Industry Sector	0.1-0.2	0.8-1.5	2.1-4.4	0.5-1.2	3.5-6.0	7.3-16.2	2.6-5.2	16.7-29.4	43.6-92.8
Building Technology, State & Community Sector	0.07-0.09	1.4-2.3	2.4-5.7	0.5-0.7	9.5-16.1	16.5-38.7	1.3-1.4	25.3-35.9	51.9-82.3
Federal Energy Management Program	0.02	0.1	0.1	0.2	0.4	0.4	0.4	1.2	1.2

Note: The program benefit ranges are developed through an impact analysis process undertaken annually by the Office of Energy Efficiency and Renewable Energy (EERE). The upper point of each range is based on analysis conducted by EERE's sectors and externally reviewed by Arthur D. Little. The sectors analyze the impacts their programs will have on energy savings, cost savings, and carbon reductions if all program goals are met. The lower point of each range for energy displaced and carbon reductions is derived from an integrated analysis model run by external contractors that controls for interaction effects. The integrated analysis model accounts for inter- and intra-sector double-counting as well as market trends, including reductions in new electricity generation. The lower point of the energy cost savings range is calculated by multiplying the total primary energy displaced, derived from the integrated analysis, by the sector's energy cost savings/total primary energy displaced ratio for that year.

Table 4 - GPRA2000 Benefit Estimates

2/11/99

Sector	PUName	Primary Energy (Tbtu)			Energy Cost Savings ($ billion)			Carbon Reduction (MMTCE)		
		2000	2010	2020	2000	2010	2020	2000	2010	2020
BTS	**Commercial Buildings Integration**	10	207	535	$0.06	$1.54	$4.11	0.17	3.42	8.62
	Community Partnerships Program	8	225	434	$0.05	$1.49	$2.97	0.13	3.58	6.76
	Energy Star	3	106	210	$0.02	$0.79	$1.57	0.05	1.67	3.14
	Equipment, Materials & Tools	36	1,369	3,542	$0.30	$9.73	$23.77	0.77	21.23	49.55
	Residential Buildings Integration	2	131	341	$0.01	$0.99	$2.60	0.03	2.17	5.50
	State Energy Program	6	56	99	$0.03	$0.36	$0.65	0.10	0.90	1.59
	Technology Roadmaps and Competitive R&D	0	100	347	$0.00	$0.65	$2.04	0.00	1.39	4.22
	Weatherization Assistance Program	7	96	184	$0.04	$0.53	$1.05	0.11	1.53	2.94
	BTS TOTAL (non-integrated)	70	2,290	5,692	$0.52	$16.08	$38.74	1.36	35.88	82.32
	BTS TOTAL (integrated)	90	1,350	2,430	$0.67	$9.48	$16.54	1.40	25.30	51.90
OIT	**Advanced Materials (CFCC and AIM)**	0	93	237	$0.00	$0.29	$0.73	0.00	1.54	4.11
	Agriculture Vision	0	0	0	$0.00	$0.00	$0.00	0.00	0.00	0.00
	Aluminum Vision	0	49	187	$0.00	$0.20	$0.60	0.00	1.04	4.44
	Chemicals Vision	0	151	830	$0.00	$0.34	$1.02	0.00	1.87	7.58
	Cogeneration - CHP	27	198	435	$0.16	$1.21	$2.71	0.65	5.52	14.85
	Forest & Paper Products Vision	0	194	1,508	$0.00	$0.74	$5.66	0.00	4.56	37.28
	Glass Vision	0	40	73	$0.00	$0.14	$0.30	0.00	0.70	1.27
	IAC	71	93	99	$0.30	$0.37	$0.38	1.51	1.98	2.11
	Integrated Delivery Program	27	158	331	$0.11	$0.60	$1.25	0.58	3.05	6.61
	Inventions & Innovations	112	107	117	$0.43	$0.45	$0.50	2.12	1.96	2.07
	Metals Casting Vision	0	20	77	$0.00	$0.09	$0.31	0.00	0.51	1.87
	Mining Vision	0	0	0	$0.00	$0.00	$0.00	0.00	0.00	0.00
	NICE-3	19	109	144	$0.07	$0.46	$0.62	0.36	2.00	2.55
	Petroleum Refining Vision	0	218	340	$0.00	$0.66	$0.99	0.00	4.02	6.06
	Steel Vision	0	36	110	$0.00	$0.07	$0.24	0.00	0.63	1.94
	OIT TOTAL (non-integrated)	257	1,467	4,489	$1.07	$5.62	$15.31	5.22	29.38	92.74
	OIT TOTAL (integrated)	130	840	2,050	$0.54	$3.22	$6.99	2.60	16.70	43.60
OTT	**Advanced Automotive Technologies**	0	638	1,590	$0.00	$6.11	$15.71	0.00	10.00	27.19
	Biofuels	0	360	1,001	$0.00	$0.00	$0.07	0.00	6.77	18.84
	Fuel Utilization									
	Heavy Duty Vehicle Technologies	7	205	396	$0.07	$2.75	$5.05	0.18	3.87	7.48
	Technology Deployment	0	0	0	$0.13	$0.85	$0.70	0.27	1.82	1.94
	Transportation Materials Technologies	0	12	50	$0.00	$0.16	$0.58	0.00	0.25	1.03
	OTT TOTAL (non-integrated)	7	1,215	3,037	$0.19	$9.87	$22.11	0.44	22.71	56.47
	OTT TOTAL (integrated)	70	960	1,660	$1.82	$7.80	$12.09	1.40	17.00	26.50
OPT	Biomass Power R&D	28	422	533	$0.01	-$0.15	-$0.21	0.62	10.49	12.95
	Energy Storage	0	1	1	$0.00	$0.00	$0.00	0.01	0.02	0.02
	Geothermal Energy R&D (Generation)	56	182	248	$0.11	$0.46	$0.71	1.08	3.10	4.06
	High Temperature Superconductivity	0	0	9	$0.00	$0.24	$1.03	0.00	0.00	0.14
	Hydrogen	4	92	642	$0.00	$0.10	$1.62	0.06	1.34	9.31
	Hydropower	8	80	183	$0.02	$0.20	$0.53	0.15	1.35	3.00
	Open Solicitation	1	3	3	$0.00	$0.00	$0.01	0.01	0.06	0.06
	Photovoltaic Systems R&D	0	6	49	$0.00	$0.02	$0.16	0.00	0.08	0.72
	Power Systems Integration	23	124	132	$0.00	$0.00	$0.00	0.50	2.70	2.82
	Solar Buildings	3	30	112	$0.00	$0.00	$0.00	0.05	0.47	1.70
	Solar International	0	0	0	$0.00	$0.00	$0.00			
	Solar Thermal	0	4	29	$0.00	$0.01	$0.09	0.00	0.06	0.42
	Wind Energy R&D	20	207	613	$0.04	$0.52	$1.76	0.39	3.52	10.05
	OPT TOTAL (non-integrated)	144	1,152	2,554	$0.17	$1.40	$5.70	2.90	23.19	45.26
	OPT TOTAL (integrated)	0	700	1,350	$0.00	$0.85	$3.02	-0.10	14.90	33.20
FEMP	FEMP	24	67	67	$0.16	$0.40	$0.38	0.44	1.21	1.21
	FEMP TOTAL	24	67	67	$0.16	$0.40	$0.38	0.44	1.21	1.21
EERE	TOTAL (non-integrated)	502	6,190	15,838	$2.11	$33.38	$82.25	10.36	112.36	278.00
	TOTAL (integrated + FEMP)	304	3,917	7,547	$3.18	$21.75	$39.01	5.74	75.21	156.41

Bold = ADL Reviewed Planning Unit

Appendix A

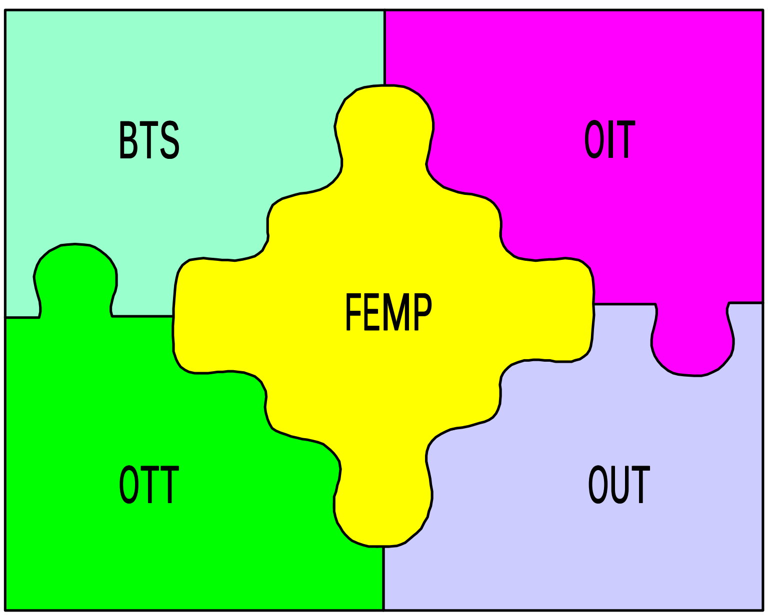
EERE

GPRA Data Call

Fiscal Year 2000

GPRA Data Call
Fiscal Year 2000

Answer Sheet



June 26, 1998

Form available at http://bowens2.nrel.gov/gpra

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INTRODUCTION

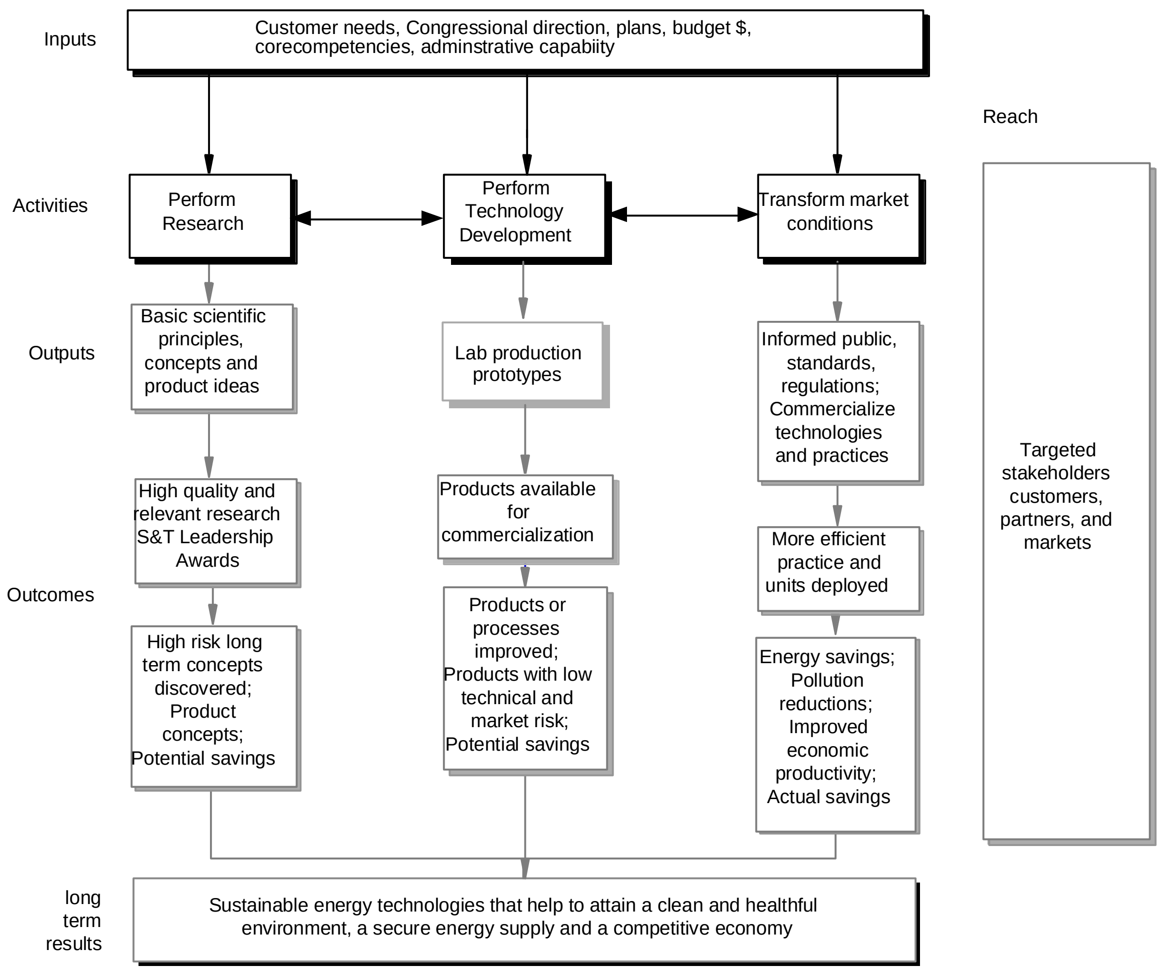
Background

The objective of the GPRA 2000 data call is to collect information that will meet the growing strategic management requirements of the White House, Congress, the Department of Energy and EE itself. The Department's approach to strategic management integrates planning, budget formulation, budget execution and evaluation. There are both legal and informal requirements for collecting the information necessary to support strategic management.

Legal requirements of strategic management include the Government Performance and Results Act of 1993 (GPRA), the National Performance Review's Performance Agreements with the President, and Executive Order 12862 on setting Customer Service Standards. Of particular importance is GPRA, which took effect in Fiscal Year 1999. GPRA requires that each agency develop a strategic plan and annual performance plans that link to the strategic plan. EE will provide input into DOE's FY2000 Performance Plan, which identifies the Department's major goals for FY2000, measures that will indicate whether those goals have been met, the current level of performance, and the resources required to meet the goals. This information may be summarized in a logic chart, which captures an organizations inputs, activities, outputs, outcomes, and longer-term results. A sample logic chart for EE is presented below in Figure 1. This year's data call is structured to capture the type of information in the logic chart. Although not required, each planning unit is strongly encouraged to develop its own logic chart.

Throughout the year, the DOE Secretary, the EE Assistant Secretary, Deputy Assistant Secretaries, and program staffs respond to numerous informal, but equally important, external requests for information at varying levels of detail on program budget, activities, accomplishments, progress, and benefits. Information is also required for internal budget allocation decisions and financial management. In addition, all of us experience the need to be proactive about presenting this information to others, both internal to EE for budget and promotion decisions and external to our potential customers and investors.

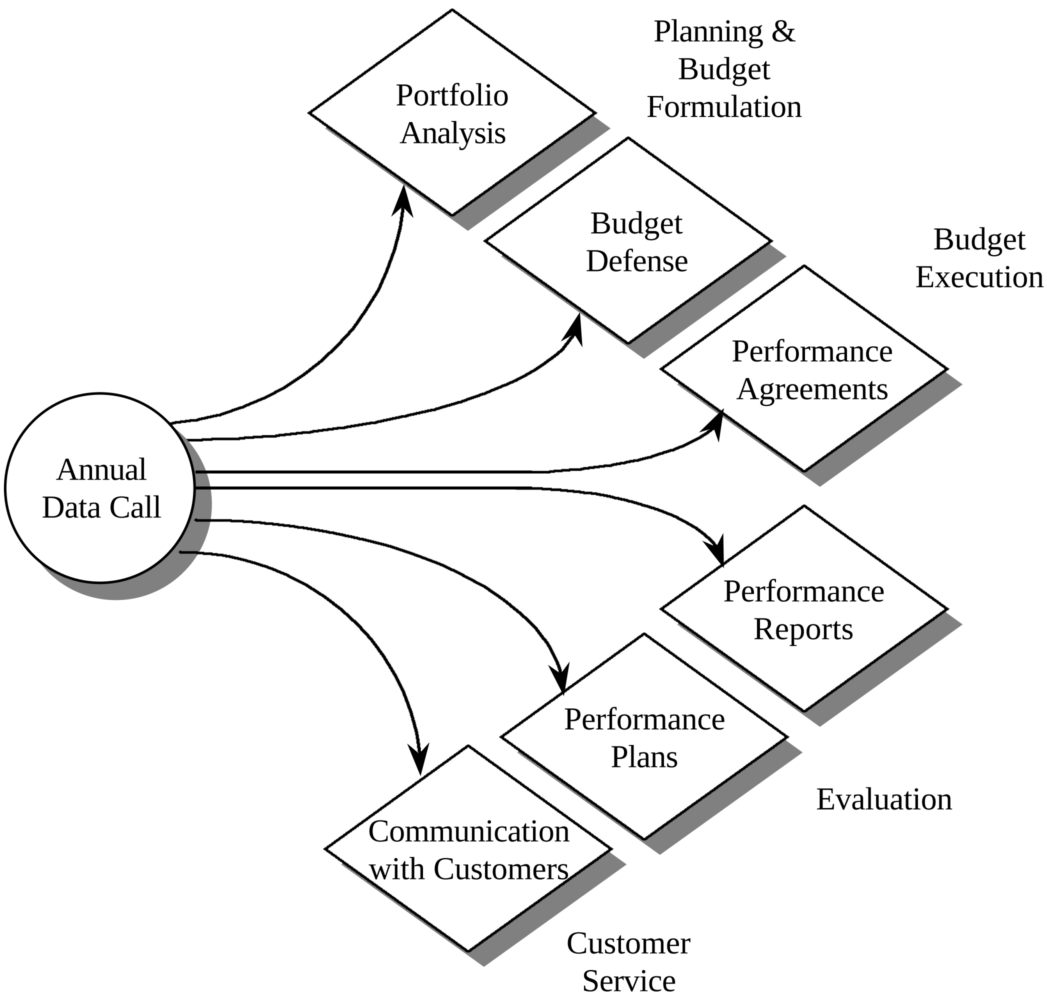
Figure 1: Sample EE Logic Chart



How Collected Data Will Meet Requirements

Information collected in current and past data calls helps EE and its programs meet the legal and informal needs and requirements identified above. Figure 2 indicates specific ways the data are used during the strategic management cycle which in turn meets GPRA and other legal requirements. During the planning and budget formulation phases the data are used in portfolio analysis and defense of budget allocations. Performance agreements are finalized once budget allocation is known, and progress relative to these targets measured during the budget execution phase. A performance plan will be developed that states expected outcomes during FY2000 for the taxpayer's investment in the EE programs.

Figure 2: Uses of Data Collected in FY2000 Data Call



SECTION A

5-Year Goal Statement

A well structured 5-year goal is a brief statement that describes the results an organization expects to achieve and how it intends to achieve them. This goal provides important context for annual progress commitments, particularly for persons not familiar with EERE programs. The goal should be measurable, quantitative where possible, and linked with annual progress goals. The 5-year goal statements should also be consistent with similar statements developed for EERE's FY2000 budget request.

With the DOE five year budget cycle, the end year for the 5-year goal will preferably be 2004. However, a program may use an existing, more logical end year such as 2003 or 2005. An example format for a 5-year goal statement would read as follows:

> By 2004, in collaboration with [major partner groups], the [planning unit name] will engage in [research, development, and/or deployment activities] in order to address [strategies] to achieve the [long-term results] which will meet the need(s) of [customers] when compared to [the base year or base level] for these results.

"Strategies" are an important component of the 5-year goal statement, as they identify the method for achieving the longer term goal and provide the basis for organizing annual milestones. See Appendix A and the Milestones and Assumptions section for additional explanation.

Please write your 5-year goal statement in the box below. Alternatively, the 5-year goal statement may be entered directly into the GPRA database located on the world-wide web at http://bowens2.nrel.gov/gpra (a secure site). The default value in the database is the 5-year goal statement provided for the FY 1999 data call.

SECTION B

FY1997 & FY1998 Accomplishments

GPRA requires that departments provide a basis of comparison for their performance goals and measures. That is, what is the current or past level of performance? Accordingly, the accomplishments tables that follow request current (FY1997 & FY1998) levels of performance for the goals and impact estimates you will provide in the remainder of the data call: resources received, milestones accomplished, as well as energy, financial and environmental impacts. Accomplishments should be consistent with information provided for EERE's FY2000 budget request.

Data may be entered into the tables that follow or directly into the GPRA database located on the world-wide web at http://bowens2.nrel.gov/gpra (a secure site).

FY1997 Accomplishments

RESOURCES

	$ million
1997 Budget Request	
1997 Budget Appropriation	
1997 Partners Investment	
1997 Partners Non-Financial Investment	

MILESTONES

FY1997 Milestones Accomplished	Actual Milestone Cost to EE ($ million)

ENERGY, FINANCIAL, AND ENVIRONMENTAL IMPACTS

Target Market	Unit of Measurement	Number of Units in the Market	Primary Energy Displaced (trillion Btu)	Energy Cost Savings ($ million)	Carbon Displaced (MMTCE)

FY1998 Accomplishments

RESOURCES

	$ million
1998 Budget Request	
1998 Budget Appropriation	
1998 Partners Investment	
1998 Partners Non-Financial Investment	

MILESTONES

FY1998 Milestones Accomplished	Actual Milestone Cost to EE ($ million)

ENERGY, FINANCIAL, AND ENVIRONMENTAL IMPACTS

Target Market	Unit of Measurement	Number of Units in the Market	Primary Energy Displaced (trillion Btu)	Energy Cost Savings ($ million)	Carbon Displaced (MMTCE)

SECTION C

Inputs: Resources Metric

Resources significantly impact the ability of planning units to achieve their goals. We are therefore requesting information about the level of resources used in estimating your planning unit's milestones and impacts. The table that follows requests information about the planning unit's funding estimates for FY1999 through FY2004, the percentage of funding allotted to research, development, and deployment, the level of partner investment in the planning unit (both financial and non-financial), and the number of partners with whom you are working. Estimates only need to be provided through FY2004 (i.e., fields for 2005-2020 may be left blank). Funding level estimates should be consistent with the "Program Outyear Funding Table" developed for EERE's FY2000 budget request (table attached).

Resource metrics may be entered into the table that follows or directly into the GPRA database located on the world-wide web at http://bowens2.nrel.gov/gpra (a secure site). The default values in the database are the values provided for the FY 1999 data call.

Program Outyear Funding Table
FY 1999 to FY 2004
(Dollars in thousands)

Budget Decision Unit	FY 00 Request	FY 01 Request	FY 02 Request	FY 03 Request	FY 04 Request
Interior Programs					
Transportation Technologies					
Electric Vehicles R&D	11,000	10,000	9,000	4,600	4,000
Hybrid Systems R&D	51,900	47,000	45,000	45,000	39,000
Fuel Cell R&D	40,000	45,000	52,000	55,000	53,600
Heat Engine R&D	52,000	47,000	40,000	35,000	35,000
CARAT	7,000	8,000	8,000	12,000	12,000
Heavy Vehicles R&D	5,000	3,000	3,000	3,000	3,000
Fuels Utilization R&D	22,000	24,000	26,000	30,000	30,000
Materials Technologies	36,000	34,000	34,000	32,000	40,000
Technology Deployment	17,000	18,600	19,600	20,000	20,000
Program Direction and Analysis	9,200	9,500	9,500	9,500	9,500
subtotal	251,100	246,100	246,100	246,100	246,100
Industrial Technologies					
Forest Products	12,076	14,200	14,300	15,600	17,800
Steel	10,627	12,500	12,500	13,600	15,600
Aluminum	8,178	9,700	9,700	10,500	12,000
Metal Casting	5,797	6,800	6,800	7,500	8,500
Glass	4,830	5,700	5,800	6,200	7,000
Chemicals	12,492	14,700	14,700	16,100	18,300
Mining	3,000	3,500	4,000	4,000	4,000
Agriculture	4,000	4,000	5,000	5,000	5,000
Environmental Solicitations	10,000	10,000	10,000	10,000	0
Enabling Technologies	50,800	37,000	35,000	29,000	29,000
Financial Assistance	12,500	13,000	13,000	13,000	13,000
Technical Assistance	22,800	25,800	25,800	25,800	25,800
Management	9,500	9,700	10,000	10,300	10,600
subtotal	166,600	166,600	166,600	166,600	166,600

Program Outyear Funding Table (cont.)

Budget Decision Unit	FY 00 Request	FY 01 Request	FY 02 Request	FY 03 Request	FY 04 Request
Interior Programs					
Building Technologies					
Residential Buildings	13,038	15,038	15,038	15,038	15,038
Commercial Buildings	5,825	6,825	6,825	6,825	6,825
Technology Roadmaps	6,000	6,000	6,000	6,000	6,000
Equipment, Materials & Tools	49,300	50,925	50,300	50,300	50,300
State Energy	37,564	36,314	36,314	36,314	36,314
Weatherization	154,100	149,100	149,100	149,100	149,100
Community Outreach	31,400	31,400	31,400	31,400	31,400
Energy Star	5,000	6,000	6,000	6,000	6,000
Management & Planning	15,318	15,943	16,568	16,568	16,568
subtotal	317,545	317,545	317,545	317,545	317,545
Federal Energy Management					
Project Financing	13,864	8,130	5,760	3,170	1,900
Technical Assistance	10,704	9,020	7,440	5,550	4,700
Planning and Evaluation	6,400	4,530	4,000	4,000	4,000
Management	2,900	2,900	2,900	2,900	2,900
subtotal	33,868	24,580	20,100	15,620	13,500
Policy and Management					
Headquarters Salaries/Support	16,975	16,975	10,252	10,252	16,975
Golden Salaries/Support	4,752	4,790	4,790	4,790	4,790
RSO Salaries/Support	17,045	17,045	14,990	14,990	16,445
Centers of Excellence	2,000	2,000	2,000	2,000	2,000
International Market Development	2,900	2,900	2,900	2,900	2,900
Information and Communication	2,000	2,000	2,000	2,000	2,000
Strategic Policy Initiatives	0	2,500	2,500	2,500	2,500
Crosscutting Activities	0	0	0	0	0
subtotal	45,672	48,210	39,432	39,432	47,610
TOTAL	814,785	803,035	789,777	785,297	791,355
PODRA	(25,000)	(25,000)	(25,000)	(25,000)	(25,000)
Interior Total	789,785	778,035	764,777	760,297	766,355
CFO targets	737,515	740,946	744,500	725,490	725,490

Program Outyear Funding Table (cont.)

Budget Decision Unit	FY 00 Request	FY 01 Request	FY 02 Request	FY 03 Request	FY 04 Request
EWD Programs					
Solar and Renewable Energy					
Solar Buildings	4,500	4,500	4,500	4,000	4,000
Photovoltaics	74,000	74,000	74,000	70,000	66,500
Million Solar Roofs	10,000	0	0	0	0
Solar Thermal	18,700	18,700	18,300	18,000	18,000
Biopower	41,400	41,600	37,000	32,000	32,000
Biofuels	44,991	45,000	45,000	46,000	46,000
Wind Power	42,600	41,000	40,000	38,000	38,000
REPI	1,500	1,500	1,500	1,500	1,500
Competitive Solicitation	8,000	8,000	8,000	8,000	8,000
Restructuring	2,000	2,500	2,000	1,300	1,000
Solar International	6,000	6,000	6,000	6,200	7,000
Solar Technology Transfer	0	0	0	0	0
NREL Facilities	6,409	5,000	5,000	7,000	7,000
Geothermal	29,500	29,000	33,000	35,000	35,000
Hydrogen	24,000	25,000	27,000	37,000	40,000
Hydropower	7,000	17,500	17,500	17,500	17,500
Superconductivity	32,000	36,000	36,000	36,000	36,000
Energy Storage	6,000	9,000	10,000	11,000	11,000
Power Systems Integration & Reliability	4,000	0	0	0	0
Climate Challenge	0	0	0	0	0
Resource Assessment	3,000	0	0	0	0
Program Direction	17,500	17,500	17,500	17,500	17,500
TOTAL	383,100	381,800	382,300	386,000	386,000
CFO targets	383,100	381,868	382,322	386,377	347,739

Building Envelope R&D (BTS) GPRA2000 Data Submission

Data Submitted by Donna Hostick (PNNL)

Resource Metrics

Metric	1997	1998	1999	2000	2001	2002	2003	2004
GPRA2000 DOE Funding Level (Millions of $'s)								
GPRA99 DOE Funding Level (Millions of $'s)			$11.749	$12.100	$12.500	$12.900	$13.400	
GPRA2000 Research (%)								
GPRA99 Research (%)		5%	5%	5%	5%	5%	5%	
GPRA2000 Development (%)								
GPRA99 Development (%)		60%	60%	60%	60%	60%	60%	
GPRA2000 Deployment (%)								
GPRA99 Deployment (%)		35%	35%	35%	35%	35%	35%	
GPRA2000 Partner Financial Investment (Millions of $'s)								
GPRA99 Partner Financial Investment (Millions of $'s)	$11.000		$5.000	$8.000	$55.000	$55.000	$55.000	
GPRA2000 Partner Non-Financial Investment (Millions								
GPRA99 Partner Non-Financial Investment (Millions of $'s)	$25.000		$5.000	$10.000	$15.000	$30.000	$45.000	
GPRA2000 Partners (Number)								
GPRA99 Partners (Number)			145	300	500	960	1,200	

SECTION D

Outputs: Milestones and Assumptions

This section of the data call collects information about milestones and assumptions for the planning unit's technologies and/or deployment activities. Milestones and assumptions describe the outputs leading to, and the underlying factors behind, planning unit impact estimates and long-term goals. Milestones also document the steps that must be completed for some of the assumptions to be realized. For example, a program manager may estimate that a technology will save 50 TBtu of energy in 2005. A key assumption behind this estimate is that the technology will penetrate 20% of the target market by the year 2005. To help reach this target, the planning unit has milestones intended to bring about the 20% market penetration target. These and other milestones and assumptions should be provided.

Milestones are grouped along to two dimensions. First, milestones are classified by the strategy in the 5 year goal statement to which they pertain. A strategy is a method for achieving longer term goals and a planning unit may have one or more of them. For instance, a goal may be to achieve an 80 mpg vehicle by 2004. A strategy for achieving this goal is to reduce the weight of the vehicle. Milestones related to this strategy would be placed on one sheet and milestones related to another strategy (e.g., improving aerodynamics) on a separate sheet. Second, milestones are grouped according to whether they are intended to improve a technology's characteristics or its penetration into the market (milestones may also be tagged as "other" when they do not easily fall into one of the other two categories). Accompanying each milestone should be an estimate of the cost to EERE for achieving that milestone. This estimate is only cumulative when the cost has occurred over a number of years and has not been included in an earlier milestone. To the extent possible, costs should only be counted under one milestone even though the work may overlap with other milestones. **Although it appears numerous milestones are being requested, only one or two milestones per year need to be submitted. Strategies, technology characteristics, and market penetration are simply means of classifying the milestones. Milestones should be significant enough to include in the Secretary's Performance Agreement with the President and should be consistent with milestones provided in EERE's FY2000 budget request.**

Milestones may entered into the tables that follow (copies may be made if there is more than one strategy) or directly into the GPRA database located on the world-wide web at http://bowens2.nrel.gov/gpra (a secure site). Milestones from last year's data call are contained on the web but should be updated for this year's effort.

A format for assumptions is not being provided this year. Each sector is free to develop its own format, as long as the format allows assumptions to be easily related to both milestones and impacts. At a minimum, assumptions should identify the target market size, market penetration levels, technology performance levels, and technology cost. **Assumptions should be submitted along with the remainder of the data call**.

GPRA 2000 Milestones

Strategy:		
Fiscal Year	**Technology Characteristics Milestones**	**Estimated Milestone Cost to EE ($ million)**
1999		
2000		
2001		
2002		
2003		
2004		
XXXX	**Market Penetration Milestones**	XXXXXXXX
1999		
2000		
2001		
2002		
2003		
2004		
XXXX	**Other Milestones**	XXXXXXXX
(year)		

SECTION E

Impacts: Energy, Financial, and Environmental Metrics

This section requests information on planning unit impacts in three areas: energy, financial, and environmental. The majority of information being requested is similar to last year's data call.

When providing information in this section, it is important that you clearly understand what data are being requested. To assist in this effort, a definition of all key terms appears in Appendix A. We encourage you to review these definitions if there is uncertainty regarding the meaning of a term.

In addition, please refer to Appendix B (*Calculations Methodology and Assumptions*) if you have questions about the assumptions that are common to the costs and benefits calculations of all the sectors, as well as if you have questions about how to calculate certain metrics.

Energy, Financial and Environmental metrics may be entered into the tables that follow or directly into the GPRA database located on the world-wide web at http://bowens2.nrel.gov/gpra (a secure site). The default values in the database are the values provided for the FY 1999 data call.

Building Envelope R&D (BTS) GPRA2000 Data Submission

Data Submitted by: Donna Hostick (PNNL)

Energy Metrics

Metric	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
GPRA2000 Total Primary Energy Displaced (Trillion Btu)										
GPRA99 Total Primary Energy Displaced (Trillion Btu)	3.69	6.78	10.47	15.08	22.43		41.93	150.98	331.79	541.21
GPRA2000 Direct Electricity Displaced (Billion Kilowatthours)										
GPRA99 Direct Electricity Displaced (Billion Kilowatthours)	0.35	0.58	0.86	1.22	1.74		3.15	11.06	24.56	40.63
GPRA2000 Direct Natural Gas Displaced (Billion Cubic Feet)										
GPRA99 Direct Natural Gas Displaced (Billion Cubic Feet)	0.07	0.73	1.34	2.24	3.79		8.19	31.42	66.08	101.68
GPRA2000 Direct Petroleum Displaced (Million Barrels)										
GPRA99 Direct Petroleum Displaced (Million Barrels)	0	0.01	0.02	0.05	0.08		0.19	0.80	1.86	3.08
GPRA2000 Direct Coal Displaced (Million Short Tons)										
GPRA99 Direct Coal Displaced (Million Short Tons)	0	0	0	0	0		0	0	0	0

Financial Metrics

Metric	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
GPRA2000 Energy Costs or Savings (Billions of $'s)										
GPRA99 Energy Costs or Savings (Billions of $'s)	$0.028	$0.050	$0.075	$0.108	$0.158		$0.287	$1.000	$2.141	$3.403
GPRA2000 Non-Energy Savings or Costs (Billions of										
GPRA99 Non-Energy Savings or Costs (Billions of $'s)										

Building Envelope R&D (BTS) GPRA2000 Data Submission

Data Submitted by: Donna Hostick (PNNL)

Environmental Metrics

Metric	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
GPRA2000 CO Displaced (MMTons)										
GPRA99 CO Displaced (MMTons)										
GPRA2000 Carbon Equivalent Emissions Displaced (MMTons)										
GPRA99 Carbon Equivalent Emissions Displaced (MMTons)	0.09	0.15	0.23	0.34	0.49		0.92	3.27	7.22	11.83
GPRA2000 Other Greenhouse Emissions Displaced (MMTons)										
GPRA99 Other Greenhouse Emissions Displaced (MMTons)										
GPRA2000 SO2 Displaced (MMTons)										
GPRA99 SO2 Displaced (MMTons)	0	0	0.01	0.01	0.01		0.03	0.09	0.21	0.34
GPRA2000 NOx Displaced (MMTons)										
GPRA99 NOx Displaced (MMTons)	0	0	0	0.01	0.01		0.01	0.05	0.11	0.19
GPRA2000 Particulates Displaced (MMTons)										
GPRA99 Particulates Displaced (MMTons)										
GPRA2000 VOCs Displaced (MMTons)										
GPRA99 VOCs Displaced (MMTons)										
GPRA2000 HCs Displaced (MMTons)										
GPRA99 HCs Displaced (MMTons)										
GPRA2000 Other Environmental Benefits										
GPRA99 Other Environmental Benefits (Thousand Tons)										

APPENDIX A

Definitions

Note: Definitions appear in alphabetical order

Carbon Emissions - estimate of the amount of the carbon equivalent emissions displaced due to fuel switching or the energy displaced from the EE technologies comprising the planning unit. (S*ee Appendix B for more details on calculating this metric*).

CO Displaced - estimate of the amount of carbon monoxide displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

Deployment - percentage of program funding directed toward efforts to foster the penetration of EE-related products in commercial markets.

Development - percentage of program funding directed toward the systematic use of the knowledge or understanding gained from research that is directed toward the production of useful materials, devices, systems, or methods.

Direct Coal Displaced - total direct coal that would have been consumed by conventional technologies had not the EE technologies comprising the planning unit entered the market, minus the direct coal consumed by the EE technologies. Definition of coal includes metallurgical coal, steam coal, and net coal coke imports.

Direct Electricity Displaced - total direct electricity that would have been consumed by conventional technologies had not the EE technologies comprising the planning unit entered the market, minus the direct electricity consumed by the EE technologies.

Direct Natural Gas Displaced - total direct natural gas that would have been consumed by conventional technologies had not the EE technologies comprising the planning unit entered the market, minus the direct natural gas consumed by the EE technologies. Definition of natural gas includes pipeline fuel natural gas and compressed natural gas.

Direct Petroleum Displaced - total direct petroleum that would have been consumed by conventional technologies had not the EE technologies comprising the planning unit entered the market, minus the direct petroleum consumed by the EE technologies. Definition of petroleum includes distillate fuel, jet fuel, motor gasoline, residual fuel, liquid petroleum gasoline, and other petroleum.

DOE Funding Level - anticipated annual DOE financial investment in the planning unit. Figures should be consistent with the "Program Outyear Funding Table" provided in Section C.

Energy Costs or Savings - estimate of annual dollar savings resulting from fuel related cost reductions that are due to planning unit actions. (S*ee Appendix B for more details on calculating this metric.*)

Energy Saved or Displaced by Fuel - amount of conventional, fossil, or electric energy being directly displaced by the planning unit on an annual basis.

HC Displaced - estimate of the amount of hydro-carbons displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

Milestone Cost **-** the cost to EE to achieve a milestone. The cost may accrue over multiple years if the milestone took multiple years to achieve but not if such costs are already incorporated into earlier milestones. For example, a planning unit may plan to spend $10 million from 2000 to 2003 to achieve a milestone. The $10 million cost to achieve the milestone should be supplied if no intermediate milestones are identified between 2000 and 2003. For instance, if $3 million of the $10 million are identified in a 2001 milestone the only the remaining $7 million should be provided for 2003. There are two types of milestone costs. *Actual milestone costs* are for FY1997 and FY1998 and represent how much EE actually spent to achieve the milestone. *Estimated milestone costs* are for FY1999-2004 and represent estimates of much EE will spend to achieve the milestone.

Non-Energy Savings or Costs - dollar savings or costs related to non-fuel related operations that are due to planning unit actions. This should include items such as: operation and maintenance costs that result from the introduction of a new technology (e.g., the new equipment is considered to be more reliable and needs less maintenance and has less downtime, capital cost savings if the new technology is cheaper than the alternative, direct pollution abatement cost savings, etc.). If the technology results in cost savings, please submit the numbers as a negative. If the technology results in additional O&M costs, please submit the numbers as a positive.

NO_X Displaced - estimate of the amount of NO_X displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

Number of Units in the Market **-** the actual number of units that produce the energy, financial and environmental impacts. For example, 500 units of a technology, 100 industrial assessments, etc.

Other Environmental Benefits - estimate of the amount non-emission pollutants displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

Other Greenhouse Emissions Displaced - estimate of the amount of greenhouse emissions other than SO_2, NOx, CO, C, particulates, VOCs displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

Particulates Displaced - estimate of the amount of particulates displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

Partners - number of distinct organizations or individuals, outside of DOE, who co-fund or co-deliver an EE product or service, including related planning activities in a given year. Partners may contribute money, expertise, or participate in planning and decision making and implementation. Partners are generally distinguished from customers who make use of services, although sometimes a partner may also be a customer, or vice-versa. Partners may include industry and trade associations, federal, state and local governments, utilities, universities and non-governmental organizations.

Partners Financial Investment – total annual monetary contributions from partners to co-fund or co-deliver an EE product or service, including related planning activities in a given year.

Partners Non-Financial Investment - total annual non-monetary investment partners are contributing to EE programs comprising the planning unit (e.g., equipment, staff, or facilities devoted to R&D).

Research - percentage of program funding directed toward efforts to develop new scientific knowledge without immediate commercial objectives in mind or to advance scientific knowledge to meet a specific, recognized need.

SO_2 Displaced - estimate of the amount of SO_2 displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

Strategy – A method for achieving longer term goals. For example, reducing the weight of a vehicle or improving its aerodynamics are strategies for achieving an 80 mpg vehicle. Strategies are identified in the 5 Year Goal Statement (Section A) and are a means of grouping milestones (Section D). Strategies are also linked to assumptions. For instance, a strategy for reducing the weight of a vehicle is linked to a technology characteristic assumption (weight) used in calculating impact metrics.

Target Market - a measurement area in which the energy, financial and environmental impacts of the planning unit can most easily be quantified. For example, the name of a technology that is in the market displacing energy, industrial assessments that produce energy savings, etc.

Total Primary Energy Displaced - the amount of conventional, fossil, or electric energy being directly displaced by the planning unit on an annual basis (e.g., improved refrigerators displacing electricity; PV for peak load displacing natural gas or oil generation for peak load electricity; electric vehicles displace oil but use electricity; improved process heating displaces the industry fuel mix; etc.). If the planning unit causes fuel switching from one energy source to another (e.g., natural gas vehicles displacing petroleum fueled vehicles), record the increase in energy source consumption as a negative figure (i.e., if the planning unit increases natural gas consumption by 60,7000 cubic feet, while displacing 500 gallons of automobile gasoline, place a negative sign in front of the 60,700 cubic feet of natural gas). (S*ee Appendix B for more details on calculating this metric*).

Unit of Measurement **-** how the planning unit's impact on the target market is quantified. For example, the number of technologies deployed, the number of industrial assessments performed, etc.

VOCs Displaced - estimate of the amount of VOCs displaced annually due to fuel switching or the energy displaced from the EE technologies comprising the planning unit.

APPENDIX B

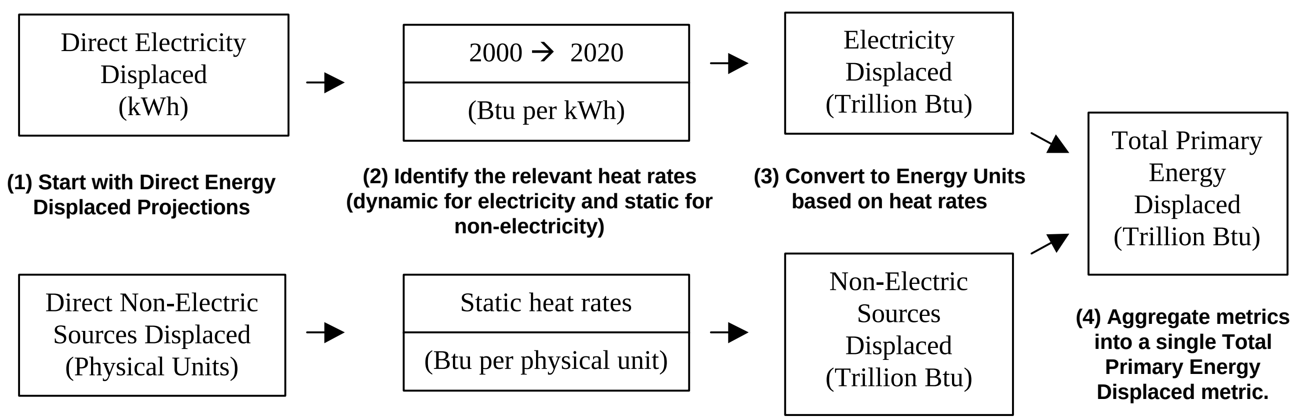
Calculation Methodologies and EIA/AEO98 Baseline Assumptions

There are a variety of methods that may be used to calculate costs and benefits of EERE programs, as well as a variety of assumptions underlying such calculations. At the same time, however, there are methods and assumptions relevant to all programs. This appendix provides formulas for calculating select energy and environmental metrics common to EERE programs and baseline assumptions to be used in those calculations. Baseline assumptions are drawn from AEO 98.

Calculation Methodologies

Converting from Direct to Primary Energy Displaced

The process for converting projections for direct energy displaced into a single total primary energy displaced metric involves four steps. These steps are displayed graphically in the diagram below.



(1) The first step in the conversion process is to identify the electric and non-electric displaced energy projections. The direct electricity displaced projections will be expressed in kilowatt-hours; the direct non-electric projections will be expressed in barrels of oil, cubic feet of natural gas, and short tons of coal.

(2) The next step involves the conversion from direct units into heat content units using the heat rate of each direct fuel source.

- Electricity Heat Rates

The heat rates used for converting the direct electricity projections from kilowatt-hours into heat content units are derived from assumptions contained within AEO98. In general, it is expected that EERE technologies will displace marginal electricity generated from fossil fuels. According to AEO98, marginal electricity generated between 2000 and 2020 will be electricity from natural gas or coal. This is evident from the projected marginal fuel mix displayed below, which is derived from AEO98 Supplemental Table 71. Oil is not included because its use is expected to decline.

Projected Marginal Fossil Fuel Generation Mix

Fuel Mix	2000	2005	2010	2015	2020
Coal	42.8%	36.5%	18.1%	26.2%	12.5%
Natural Gas	57.2%	63.5%	81.9%	73.8%	87.5%

The expected heat rates for each marginal generation source are listed in the table below. These heat rates are derived from projected electricity generation and energy consumption figures contained in AEO98 Supplemental Table 71.

Expected Electricity Heat Rates by Fuel Source

Expected Electricity Heat Rates	2000	2005	2010	2015	2020
Coal (Btu per kWh)	10283	10240	10235	10179	10147
Natural Gas (Btu per kWh)	9883	8483	8022	7441	7249

To derive the dynamic GPRA2000 electricity heat rates, the percentage of the marginal mix associated with each fuel source was multiplied by the expected electricity heat rate for the same source. This yielded the intermediate apportioned heat content associated with each generation source. Then, for each forecast year, the apportioned heat contents were summed to arrive at a final GPRA2000 heat rate. For example, in the year 2000, electricity generated from coal is expected to account for 42.8 percent of the marginal mix, electricity generated from natural gas is expected to account for the rest. The expected electricity heat rates in 2000 are 10,283 and 9,883, for coal and natural gas respectively. Therefore, the GPRA2000 heat rate for 2000 is (42.8%)(10,283) + (57.2%)(9,883) = 10,054.

GPRA2000 Electricity Heat Rates

GPRA2000 Heat Rate	2000	2005	2010	2015	2020
Electricity (Btu per kWh)	10054	9124	8423	8158	7612

• Non-Electric Heat Rates

The heat rates used for conversion of non-electric sources are much more straightforward. The table below contains the appropriate conversion factors for these sources that are based on heat rate estimates provided in AEO98 Table H1. Simply find the matching direct energy displaced source with the appropriate heat rate from the table below.

GPRA2000 Non-Electricity Heat Rates

Coal			
	Coal Production	million Btu per short ton	21.277
	Coal Consumption	million Btu per short ton	20.845
Oil			
	Crude Oil Production	million Btu per barrel	5.800
	Oil Products Consumption	million Btu per barrel	5.346
	Motor Gasoline Consumption	million Btu per barrel	5.206
	Jet Fuel Consumption	million Btu per barrel	5.670
	Distillate Fuel Oil Consumption	million Btu per barrel	5.825
	Residual Fuel Oil Consumption	million Btu per barrel	6.287
	Liquefied Petroleum Gas Consumption	million Btu per barrel	3.625
	Kerosene Consumption	million Btu per barrel	5.670
	Petrochemcial Feedstocks Consumption	million Btu per barrel	5.630
	Unfinished Oils Consumption	million Btu per barrel	5.800
Natural Gas			
	Natural Gas Production	Btu per cubic foot	1,028
	Natural Gas Consumption	Btu per cubic foot	1,029
	Natural Gas Consumption from Electric Utilities	Btu per cubic foot	1,022

(3) The third step involves multiplying the above heat rates by the direct energy displaced projections.

(4) The final step is to sum the energy displaced estimates (not expressed in heat content units) for each forecast year.

Converting from Direct to Primary Energy – An Example

To better understand the mechanics of the energy conversion process, consider the following example. The direct energy displaced projections for a hypothetical Planning Unit EE are displayed in the table below. Assume planning Unit EE is a demand-side technological development program which displaces electricity and natural gas in the Buildings sector.

Step 1 consists of simply identifying the direct energy displaced estimates for each forecast year.

Step (1)	2000	2005	2010	2015	2020
Direct Electricity Displaced (billion kWhs)	0.58	3.15	11.06	24.56	40.63
Direct Natural Gas Displaced (billion cubic feet)	0.73	8.19	31.42	66.08	101.68

In step 2, the relevant heat rates are identified. A static conversion factor is used for the non-electric projections while a dynamic heat rate is used for electricity.

Step (2)	2000	2005	2010	2015	2020
Electricity (Btu per kWh)	10054	9124	8423	8158	7612
Natural Gas Consumption (Btu per cubic foot)	1029	1029	1029	1029	1029

In step 3, all direct energy displaced estimates are converted from physical units to heat content units by multiplying by the appropriate heat rates.

Step (3)	2000	2005	2010	2015	2020
Electricity (trillion Btu)	5.83	28.74	93.16	200.36	309.27
Natural Gas (trillion Btu)	0.75	8.43	32.33	68.00	104.63

After all of the metrics have been converted to heat content units, the last step involves summing the metrics in each forecast year.

Step (4)	2000	2005	2010	2015	2020
Total Primary Energy Displaced (trillion Btu)	6.58	37.17	125.49	268.36	413.90

Calculating Carbon Equivalent Emissions Displaced

The methodology for calculating the level of carbon equivalent emissions displaced continues from the conversion of direct to primary energy displaced. Carbon emission coefficients are applied to the projections of primary energy displaced by energy source to obtain carbon equivalent emissions displaced by energy source. These estimates are then summed to arrive at a final metric of carbon equivalent emissions displaced.

In the October 1997 edition of *Emissions of Greenhouse Gases in the United States 1996*, the Energy Information Administration presents emissions coefficients for the estimation of carbon released from the combustion of fossil fuels in the United States in 1996. Emissions coefficients for more than 20 petroleum products, coal, natural gas and crude oil are provided in the table below. Although these coefficients are based on 1996 carbon emissions and energy consumption data, these are the most appropriate coefficients to use in calculating displaced carbon emissions in each forecast year.

Carbon Emissions Coefficients at Fuel Combustion 1996
(Million Metric Tons of Carbon per trillion Btu)

Fuel		1996
Petroleum Average		**0.0217**
	Motor Gasoline	0.0194
	LPG	0.0170
	Jet Fuel	0.0193
	Distillate Fuel	0.0200
	Residual Fuel	0.0215
	Asphalt and Road Oil	0.0206
	Lubricants	0.0202
	Petrochemical Feed	0.0194
	Aviation Gas	0.0189
	Kerosene	0.0197
	Petroleum Coke	0.0279
	Special Naphtha	0.0199
	Waxes and Miscellaneous	0.0198
	Industrial Sector Other	0.0408
Coal Average		**0.0257**
	Residential/Commercial	0.0260
	Industrial Coking	0.0255
	Other Industrial	0.0256
	Electric Utility	0.0257
Natural Gas		**0.0145**
Crude Oil		**0.0203**

Like the electricity heat rate, the carbon coefficient for electricity changes over the forecast period with the changing projections of the marginal fuel mix.

Electricity Carbon Coefficients
(million metric tons of carbon per trillion Btu)

Carbon Coefficient	2000	2005	2010	2015	2020
Electricity (MMTCE per trillion Btu)	0.0194	0.0191	0.0170	0.0182	0.0164

Calculating Carbon Equivalent Emissions Displaced – An Example

To better understand how to calculate displacement of carbon equivalent emissions, consider the following example, which continues from Step 3 of the direct to primary energy example.

Step (3)	2000	2005	2010	2015	2020
Electricity (trillion Btu)	5.83	28.74	93.16	200.36	309.27
Natural Gas (trillion Btu)	0.75	8.43	32.33	68.00	104.63

Instead of summing these metrics to arrive at a final total primary energy displaced metric, the appropriate carbon emissions coefficients are applied.

Step (4)	2000	2005	2010	2015	2020
Electricity (MMTCE per trillion Btu)	0.0194	0.0191	0.0170	0.0182	0.0164
Natural Gas (MMTCE per trillion Btu)	0.0145	0.0145	0.0145	0.0145	0.0145

The resultant emissions displaced projections are listed in the table below.

Step (5)	2000	2005	2010	2015	2020
Electricity (MMTCE)	0.11	0.55	1.58	3.64	5.06
Natural Gas (MMTCE)	0.01	0.12	0.47	0.99	1.52

The final step is to sum these individual estimates to arrive at a final metric of carbon equivalent emissions displaced as illustrated below (components may not sum to totals due to rounding).

Step (6)	2000	2005	2010	2015	2020
Carbon Equivalent Emissions Displaced (MMTons)	0.12	0.67	2.05	4.62	6.58

Calculating Criteria Pollutants Displaced

Calculating the amount of criteria pollutants displaced is similar to calculating the displacement of carbon equivalent emissions. Emission factors are applied to primary energy displaced by energy source to obtain criteria pollutant displacement levels by energy source. These estimates as then summed to obtain total criteria pollutant displaced levels.

The Environmental Protection Agency catalogues emission factors for numerous technologies. For the GPRA Data Call more generic emission factors have been calculated from aggregate emission and energy consumption data provided by EPA. These are provided in the tables below. Emission factors for specific technologies may be obtained from EPA's *Compilation of Air Pollutant Emission Factors* (AP-42) available on the world wide web at http://www.epa.gov/ttn/chief/ap42etc.html

Emission Factors of Criteria Pollutants
(MMTons of emissions per trillion Btu)

Fuel	NOx	SO2	VOCs	CO	PM10
Coal	0.000259	0.000562	0.000001	0.000012	0.000012
Natural Gas	0.000106	0.000041	0.000001	0.000018	0.000000
Oil	0.000121	0.000525	0.000004	0.000013	0.000007

Like the electricity carbon coefficient, the electricity criteria pollutant coefficients are dynamic, changing over time with the changing fuel mix.

Electricity Emission Factors
(MMTons of emissions per trillion Btu)

Criteria Coefficients	2000	2005	2010	2015	2020
NOx (MMTons per trillion Btu)	0.000173	0.000168	0.000139	0.000156	0.000131
SO2 (MMTons per trillion Btu)	0.000269	0.000254	0.000156	0.000211	0.000128
VOCs (MMTons per trillion Btu)	0.000001	0.000001	0.000001	0.000001	0.000001
CO (MMTons per trillion Btu)	0.000015	0.000016	0.000017	0.000016	0.000017
PM10 (MMTons per trillion Btu)	0.000005	0.000005	0.000003	0.000004	0.000002

Calculating Criteria Pollutant Emissions Displaced – An Example

To better understand the calculations behind criteria pollutants displaced, consider the following example for calculating emissions of NOx displaced. Similar steps would be taken for calculating SO2, VOCs, CO and PM10. Steps 1-3 of the energy conversion process for Planning Unit EE yielded the following energy displacement estimates by fuel source.

Step (3)	2000	2005	2010	2015	2020
Electricity (trillion Btu)	5.83	28.74	93.16	200.36	309.27
Natural Gas (trillion Btu)	0.75	8.43	32.33	68.00	104.63

Instead of summing these metrics to arrive at a total primary energy displaced metric, the appropriate emission factors are applied.

Step (4)	2000	2005	2010	2015	2020
Electricity (MMTon of NOx per trillion Btu)	0.000173	0.000168	0.000139	0.000156	0.000131
Natural Gas (MMTons of NOx per trillion Btu)	0.000106	0.000106	0.000106	0.000106	0.000106

The resultant emissions displaced for NOx are listed in the table below. Similar calculations would be performed for SO2, VOCs, CO and PM10.

Step (5)	2000	2005	2010	2015	2020
Electricity (MMTons NOx)	0.001	0.005	0.013	0.031	0.041
Natural Gas (MMTons NOx)	0.000	0.001	0.003	0.007	0.011

The final step is to sum these individual estimates to arrive at a final metric of NOx emissions displaced as illustrated below.

Step (6)	2000	2005	2010	2015	2020
NOx Displaced (MMTons)	0.001	0.006	0.016	0.038	0.052

Energy Information Administration
Annual Energy Outlook 1998
Baseline Assumption Tables

Table 20. Energy Prices by Sector and Source for the United States

Table 21. Residential Sector Supplement Table

Table 22. Commercial Sector Supplement Table

Table 23. Industrial Sector Macroeconomic Indicators

Table 24. Refining Industry Energy Consumption

Table 25. Food Industry Energy Consumption

Table 26. Paper Industry Energy Consumption

Table 27. Bulk Chemical Industry Energy Consumption

Table 28. Glass Industry Energy Consumption

Table 29. Cement Industry Energy Consumption

Table 30. Iron and Steel Industries Energy Consumption

Table 31. Aluminum Industry Energy Consumption

Table 46. Light-Duty Vehicle MPG by Technology Type (MPG Gasoline Equivalents)

Table 71. Electric Power and Projections for the United States

Please contact John Mortensen at NREL (john_mortensen@nrel.gov) if you would like copies of the above tables in spreadsheet format. All AEO98 supplemental tables may be found on the EIA website at **http://www.eia.doe.gov/forecasting_index.html**

Table 20. Energy Prices by Sector and Source
(1996 Dollars per Million Btu)
US Average

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Residential....................	12.49	12.45	12.46	12.37	12.39	12.31	12.31	12.21	11.91	11.97
Primary Energy 1/............	6.34	6.32	6.34	6.29	6.27	6.24	6.23	6.15	6.07	6.17
Petroleum Products 2/......	8.57	8.67	8.79	8.85	8.93	9.05	9.20	9.42	9.54	9.70
Distillate Fuel..........	7.08	7.15	7.23	7.25	7.29	7.38	7.47	7.55	7.64	7.71
Liquefied Petroleum Gas..	11.48	11.56	11.68	11.77	11.87	12.00	12.21	12.45	12.43	12.57
Natural Gas................	5.81	5.77	5.77	5.69	5.64	5.59	5.55	5.42	5.32	5.44
Electricity..................	23.29	22.93	22.61	22.37	22.36	22.13	22.04	21.43	20.40	20.01
Commercial.....................	12.51	12.33	12.21	12.10	12.05	11.94	11.84	11.63	11.19	11.15
Primary Energy 1/............	4.92	4.91	4.93	4.88	4.86	4.84	4.82	4.79	4.77	4.91
Petroleum Products 2/......	5.49	5.54	5.63	5.65	5.72	5.78	5.87	6.02	6.12	6.25
Distillate Fuel..........	5.17	5.23	5.30	5.33	5.38	5.45	5.53	5.65	5.75	5.86
Residual Fuel...........	3.01	2.97	3.04	3.02	3.10	3.06	3.06	3.16	3.28	3.40
Natural Gas 3/............	4.90	4.88	4.88	4.82	4.78	4.74	4.71	4.66	4.62	4.77
Electricity..................	21.46	21.02	20.68	20.47	20.33	20.08	19.81	19.16	18.02	17.58
Industrial 4/..................	4.95	4.92	4.95	4.96	4.99	5.01	5.04	5.15	5.10	5.21
Primary Energy..............	3.57	3.59	3.64	3.66	3.69	3.73	3.79	3.97	4.04	4.20
Petroleum Products 2/......	4.91	4.96	5.03	5.08	5.15	5.21	5.32	5.53	5.55	5.70
Distillate Fuel..........	5.21	5.24	5.32	5.35	5.43	5.49	5.56	5.74	5.88	6.07
Liquefied Petroleum Gas..	5.92	5.98	6.09	6.17	6.26	6.38	6.60	6.76	6.64	6.81
Residual Fuel...........	2.69	2.70	2.74	2.74	2.80	2.80	2.83	3.02	3.15	3.35
Natural Gas 5/............	2.75	2.73	2.76	2.75	2.75	2.75	2.77	2.93	3.00	3.17
Metallurgical Coal.........	1.77	1.76	1.74	1.73	1.73	1.72	1.71	1.68	1.67	1.66
Steam Coal................	1.42	1.41	1.40	1.39	1.38	1.37	1.36	1.33	1.31	1.30
Electricity..................	12.97	12.68	12.48	12.34	12.26	12.09	11.93	11.41	10.59	10.26
Transportation.................	8.42	8.53	8.58	8.60	8.65	8.68	8.78	8.83	8.86	8.87
Primary Energy..............	8.40	8.52	8.57	8.58	8.63	8.66	8.76	8.81	8.84	8.85
Petroleum Products 2/......	8.41	8.52	8.58	8.59	8.64	8.67	8.77	8.80	8.82	8.82
Distillate Fuel 6/.......	8.52	8.53	8.60	8.60	8.66	8.70	8.74	8.61	8.60	8.52
Jet Fuel 7/.............	5.00	5.12	5.20	5.25	5.36	5.43	5.58	5.85	6.05	6.27
Motor Gasoline 8/........	9.61	9.78	9.83	9.86	9.91	9.94	10.06	10.18	10.22	10.24
Residual Fuel...........	2.56	2.61	2.67	2.69	2.79	2.82	2.85	3.07	3.14	3.32
Liquid Petroleum Gas 9/..	12.75	12.80	12.88	12.94	13.01	13.09	13.27	13.30	13.07	13.01
Natural Gas 10/...........	5.52	5.46	5.44	5.42	5.47	5.57	5.72	6.60	7.06	7.39
E85 11/....................	15.56	15.81	15.91	15.95	15.99	16.07	16.30	16.71	17.04	17.79
Electricity..................	14.91	14.66	14.43	14.20	14.02	13.78	13.69	13.25	12.54	12.26
Average End-Use Energy.........	8.24	8.26	8.28	8.26	8.29	8.29	8.33	8.35	8.28	8.35
Primary Energy...............	7.91	7.94	7.96	7.95	7.99	8.00	8.05	8.09	8.04	8.11
Electricity..................	19.26	18.93	18.65	18.44	18.35	18.12	17.94	17.32	16.36	16.01
Electric Generators 12/										
Fossil Fuel Average..........	1.47	1.46	1.47	1.47	1.47	1.48	1.49	1.57	1.60	1.66
Petroleum Products.........	3.16	3.21	3.28	3.32	3.51	3.59	3.57	3.84	4.00	4.21
Distillate Fuel..........	4.80	4.84	4.91	4.93	5.04	5.09	5.16	5.33	5.47	5.64
Residual Fuel...........	2.89	2.95	2.99	3.03	3.18	3.23	3.20	3.46	3.60	3.77
Natural Gas................	2.43	2.48	2.53	2.55	2.55	2.60	2.63	2.84	2.98	3.15
Steam Coal................	1.22	1.20	1.19	1.17	1.16	1.15	1.14	1.09	1.03	0.97
Average Price to All Users 13/										
Petroleum Products 2/........	7.48	7.59	7.66	7.69	7.77	7.82	7.92	8.02	8.06	8.12
Distillate Fuel	7.61	7.65	7.73	7.74	7.80	7.85	7.92	7.88	7.91	7.90
Jet Fuel..................	5.00	5.12	5.20	5.25	5.36	5.43	5.58	5.85	6.05	6.27
Liquefied Petroleum Gas....	7.06	7.12	7.25	7.34	7.46	7.60	7.84	8.09	8.05	8.24
Motor Gasoline 8/..........	9.59	9.76	9.82	9.84	9.89	9.92	10.05	10.16	10.21	10.23
Residual Fuel.............	2.70	2.73	2.78	2.80	2.88	2.90	2.92	3.12	3.21	3.38
Natural Gas..................	3.76	3.74	3.75	3.71	3.69	3.67	3.66	3.70	3.72	3.86
Coal.........................	1.24	1.22	1.21	1.19	1.18	1.17	1.16	1.11	1.05	1.00
E85 11/......................	15.56	15.81	15.91	15.95	15.99	16.07	16.30	16.71	17.04	17.79
Electricity..................	19.26	18.93	18.65	18.44	18.35	18.12	17.94	17.32	16.36	16.01

Table 20. Energy Prices by Sector and Source
(1996 Dollars per Million Btu)
US Average

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Non-Renewable Energy Expentures										
by Sect.(billion 1996 dollars)										
Residential....................	132.27	133.89	135.13	135.10	136.19	136.61	137.30	141.87	144.47	150.85
Commercial....................	96.58	96.19	96.17	96.28	96.82	96.99	97.11	99.96	99.87	100.74
Industrial....................	130.75	130.95	132.78	134.40	136.06	137.83	140.45	151.07	152.83	157.75
Transportation................	217.57	224.71	231.03	236.14	242.04	247.48	254.98	278.70	293.73	306.35
Total Non-Renewable Expend...	577.16	585.74	595.11	601.93	611.12	618.91	629.83	671.60	690.90	715.69
Trans. Renew. Expenditures...	0.05	0.05	0.06	0.07	0.08	0.26	0.45	1.47	2.25	2.79
Total Expenditures...........	577.21	585.79	595.17	601.99	611.19	619.17	630.28	673.07	693.15	718.48

1/ Weighted average price includes fuels below as well as coal.
2/ This quantity is the weighted average for all petroleum products, not just those listed below.
3/ Excludes independent power producers.
4/ Includes cogenerators.
5/ Excludes uses for lease and plant fuel.
6/ Low sulfur diesel fuel. Price includes Federal and State taxes while excluding county and local taxes.
7/ Kerosene-type jet fuel. Price includes Federal and State taxes while excluding county and local taxes.
8/ Sales weighted-average price for all grades. Includes Federal and State taxes and excludes county and local taxes.
9/ Includes Federal and State taxes while excluding county and local taxes.
10/ Compressed natural gas used as a vehicle fuel. Price includes estimated motor vehicle fuel taxes.
11/ E85 is 85 percent ethanol (renewable) and 15 percent motor gasoline (nonrenewable).
12/ Includes all electric power generators except cogenerators, which produce electricity and other useful thermal energy.
13/ Weighted averages of end-use fuel prices are derived from the prices shown in each sector and the corresponding sectoral consumption.
Btu = British thermal unit.
Note: 1996 figures may differ from published data due to internal rounding.
Source: 1996 prices for all other petroleum products are derived from the EIA, State Energy Price and ExpenditureReport 1994, DOE/EIA-0376(94) (Washington, DC, June 1997). 1996 industrial gas delivered prices are based on EIA, Manufacturing Energy Consumption Survey 1991. 1996 residential and commercial natural gas delivered prices: EIA, Natural Gas Monthly, DOE/EIA-0130(97/6) (Washington, DC, June 1997). Other 1996 natural gas delivered prices: EIA, AEO98 National Energy Modeling System run AEO98B.D100197A. Values for 1996 coal prices have been estimated from EIA, State Energy Price and Expenditure Report 1994, DOE/EIA-0376(94)(Washington, DC, June 1997) by use of consumption quantities aggregated from EIA, State Energy Data Report 1994. Online. ftp://ftp.eia.doe.gov/pub/state.data/021494.pdf (August 26, 1997) and the Coal Industry Annual 1996, DOE/EIA-0584(96) (Washington, DC, November 1997). 1996 electricity prices for commercial, industrial, and transportation: EIA, AEO98 National Energy Modeling System run AEO98B.D100197A. Projections: EIA AEO98 National Energy Modeling System run AEO98B.D100197A.

Table 21. Residential Sector Supplement Table

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Equipment Stock (million units)										
Main Space Heaters										
Electric Heat Pumps..........	8.96	9.22	9.47	9.71	9.95	10.19	10.44	11.68	12.94	14.16
Electric Other...............	18.08	18.16	18.24	18.33	18.41	18.49	18.58	19.10	19.66	20.23
Natural Gas Heat Pumps.......	0.09	0.10	0.12	0.13	0.14	0.15	0.17	0.24	0.31	0.39
Natural Gas Other............	56.21	56.98	57.74	58.49	59.24	59.99	60.75	64.52	68.26	71.88
Distillate..................	9.87	9.82	9.78	9.74	9.71	9.68	9.65	9.58	9.53	9.42
Liquid Petroleum Gas.........	5.17	5.25	5.33	5.40	5.47	5.54	5.61	5.93	6.22	6.44
Kerosene....................	0.93	0.92	0.91	0.91	0.90	0.89	0.88	0.85	0.81	0.78
Wood Stoves.................	3.01	2.99	2.97	2.95	2.93	2.92	2.90	2.82	2.74	2.63
Geothermal Heat Pumps........	0.57	0.62	0.67	0.72	0.77	0.82	0.87	1.12	1.38	1.63
Total.....................	102.89	104.07	105.23	106.37	107.51	108.67	109.84	115.83	121.87	127.56
Space Cooling (million units)										
Electric Heat Pumps..........	8.96	9.22	9.47	9.71	9.95	10.19	10.44	11.68	12.94	14.16
Natural Gas Heat Pumps.......	0.09	0.10	0.12	0.13	0.14	0.15	0.17	0.24	0.31	0.39
Geothermal Heat Pumps........	0.57	0.62	0.67	0.72	0.77	0.82	0.87	1.12	1.38	1.63
Central Air Conditioners.....	40.36	41.27	42.16	43.04	43.92	44.81	45.70	50.16	54.58	58.73
Room Air Conditioners........	36.57	36.55	36.53	36.51	36.49	36.48	36.47	36.49	36.55	36.59
Total.....................	86.54	87.76	88.94	90.11	91.27	92.45	93.65	99.69	105.76	111.50
Water Heaters (million units)										
Electric....................	39.03	39.38	39.72	40.08	40.45	40.82	41.21	43.14	45.10	47.06
Natural Gas.................	55.84	56.54	57.22	57.90	58.57	59.25	59.94	63.43	66.92	70.23
Distillate..................	4.64	4.65	4.66	4.67	4.68	4.68	4.68	4.72	4.76	4.79
Liquid Petroleum Gas.........	3.87	3.99	4.11	4.21	4.31	4.40	4.49	5.02	5.53	5.92
Solar Thermal...............	0.64	0.64	0.64	0.64	0.63	0.63	0.63	0.62	0.61	0.60
Total.....................	104.03	105.21	106.36	107.50	108.63	109.79	110.95	116.92	122.93	128.60
Cooking Equipment(mill.units)1/										
Electric....................	64.32	65.15	65.98	66.79	67.61	68.44	69.29	73.69	78.03	82.31
Natural Gas.................	34.06	34.32	34.57	34.81	35.05	35.30	35.54	36.74	38.02	39.10
Liquid Petroeum Gas..........	5.76	5.83	5.90	5.96	6.03	6.09	6.15	6.47	6.82	7.08
Total.....................	104.14	105.30	106.44	107.57	108.69	109.83	110.98	116.90	122.86	128.49
Clothes Dryers (million units)										
Electric....................	61.06	62.14	63.19	64.22	65.23	66.25	67.27	72.31	77.27	81.99
Natural Gas.................	15.09	15.27	15.45	15.63	15.81	16.00	16.18	17.10	18.02	18.88
Total.....................	76.15	77.41	78.64	79.85	81.05	82.25	83.45	89.41	95.28	100.88
Other Appliances(million units)										
Refrigerators...............	108.06	109.33	110.57	111.80	113.02	114.26	115.51	121.90	128.34	134.43
Freezers....................	32.66	32.52	32.38	32.23	32.08	31.94	31.81	31.70	32.21	33.13
Stock Aver. Equipment Efficiency										
Main Space Heaters										
Electric Heat Pumps (HSPF)...	6.96	7.04	7.11	7.16	7.19	7.22	7.32	7.48	7.69	7.83
Natural Gas Heat Pumps (COP).	1.27	1.27	1.27	1.27	1.27	1.27	1.29	1.33	1.39	1.43
Geothermal Heat Pumps (COP)..	3.12	3.12	3.13	3.14	3.14	3.14	3.19	3.26	3.47	3.63
Natural Gas Furnace (AFUE)...	0.76	0.77	0.77	0.78	0.79	0.79	0.80	0.82	0.83	0.84
Distillate Furnace (AFUE)....	0.78	0.79	0.79	0.79	0.80	0.80	0.80	0.81	0.81	0.81
Space Cooling										
Electric Heat Pumps (SEER)...	10.36	10.50	10.61	10.70	10.76	10.81	11.04	11.42	11.80	12.05
Natural Gas Heat Pumps (COP).	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
Geothermal Heat Pumps (EER)..	13.38	13.40	13.43	13.44	13.46	13.47	13.64	13.92	14.59	15.11
Cent. Air Conditioners (SEER)	10.12	10.23	10.33	10.42	10.48	10.53	10.63	10.76	10.86	10.92
Room Air Conditioners (EER)..	8.69	8.77	8.93	9.02	9.11	9.18	9.25	9.47	9.62	9.72
Water Heaters										
Electric (EF)................	0.87	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Natural Gas (EF)............	0.54	0.54	0.54	0.54	0.54	0.55	0.55	0.55	0.55	0.55
Distillate (EF).............	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
Liquid Petroleum Gas (EF)....	0.54	0.54	0.54	0.55	0.55	0.55	0.55	0.55	0.56	0.56

Table 21. Residential Sector Supplement Table

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Other Appliances (kWh/yr)										
Refrigerators................	901.94	871.80	844.98	805.85	773.01	743.25	716.51	613.98	557.14	536.20
Freezers.....................	717.23	690.11	664.63	635.98	610.47	586.88	567.06	505.93	473.83	458.22
Build. Shell Eff.Index(1993=1.0)										
Space Heating										
Pre-1994 Homes...............	0.97	0.97	0.97	0.96	0.96	0.95	0.94	0.92	0.90	0.87
New Construction.............	0.86	0.85	0.85	0.84	0.83	0.82	0.81	0.76	0.72	0.66
All Homes..................	0.96	0.96	0.95	0.95	0.94	0.93	0.93	0.90	0.87	0.84
Space Cooling										
Pre-1994 Homes...............	0.98	0.98	0.98	0.97	0.97	0.96	0.96	0.94	0.92	0.90
New Construction.............	0.91	0.91	0.90	0.89	0.88	0.87	0.87	0.82	0.78	0.73
All Homes..................	0.97	0.97	0.97	0.96	0.96	0.95	0.95	0.92	0.90	0.87

1/ Does not include microwave ovens or outdoor grills.

HSPF = Heating Seasonal Performance Factor: The total heating output of a heat pump in Btu during its normal annual usage period for heating divided by total electric input in watt-hours during the same period.

COP = Coefficient of Performance: Energy efficiency rating measure determined, under specific testing conditions, by dividing the energy output by the energy input.

AFUE = Annual Fuel Utilization Efficiency: Efficiency rating based on average usage, including on and off cycling, as set out in the standardized Department of Energy test procedures.

SEER = Seasonal Energy Efficiency Ratio: The total cooling of a central unitary air conditioner or a unitary heat pump in Btu during its normal annual usage period for cooling divided by the total electric energy input in watt-hours during the same period.

EER = Energy Efficiency Ratio: A ratio calculated by dividing the cooling capacity in Btu per hour by the power input in watts at any given set of rating conditions, expressed in Btu per hour per watt.

EF = Efficiency Factor: Efficiency (measured in Btu out / Btu in) of water heaters under certain test conditions specified by the Department of Energy.

kWh/y = Kilowatt hours per year to run the appliance under certain test conditions as specified by the Department of Energy.

Btu = British thermal unit.

N/A = Not applicable.

Note: Totals may not equal sum of components due to independent rounding.

Source: EIA, AEO98 National Energy Modeling System run AEO98B.D100197A.

Table 22. Commercial Sector Supplement Table

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Building Delivered										
Energy Consumption (quad.Btu)1/										
Assembly......................	0.45	0.45	0.45	0.45	0.46	0.46	0.46	0.47	0.47	0.48
Education.....................	0.70	0.71	0.71	0.72	0.73	0.73	0.74	0.77	0.79	0.80
Food Sales....................	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.18	0.19	0.19
Food Service..................	0.34	0.34	0.34	0.35	0.35	0.35	0.36	0.37	0.38	0.38
Health Care...................	0.33	0.34	0.34	0.35	0.35	0.36	0.36	0.38	0.40	0.41
Lodging.......................	0.46	0.47	0.47	0.47	0.48	0.48	0.49	0.51	0.53	0.54
Office - Large................	0.69	0.70	0.70	0.71	0.71	0.72	0.73	0.76	0.79	0.80
Office - Small................	0.63	0.63	0.64	0.64	0.65	0.65	0.66	0.69	0.71	0.72
Mercantile/Service............	1.00	1.01	1.02	1.03	1.04	1.05	1.06	1.10	1.15	1.17
Warehouse.....................	0.55	0.56	0.57	0.57	0.58	0.58	0.59	0.62	0.64	0.65
Other.........................	0.58	0.59	0.60	0.61	0.63	0.64	0.65	0.71	0.75	0.78
Total.......................	5.90	5.96	6.02	6.07	6.13	6.20	6.26	6.55	6.81	6.90
Commercial Building Floorspace										
(billion square feet)										
Assembly......................	8.68	8.73	8.77	8.80	8.84	8.88	8.92	9.10	9.26	9.32
Education.....................	9.35	9.49	9.63	9.77	9.90	10.04	10.17	10.81	11.27	11.43
Food Sales....................	0.84	0.85	0.86	0.87	0.88	0.89	0.89	0.94	0.97	0.99
Food Service..................	1.61	1.62	1.63	1.64	1.65	1.67	1.68	1.74	1.79	1.80
Health Care...................	1.47	1.49	1.51	1.53	1.55	1.57	1.58	1.66	1.71	1.74
Lodging.......................	3.12	3.16	3.20	3.23	3.27	3.30	3.33	3.50	3.65	3.69
Office - Large................	6.86	6.89	6.92	6.95	6.98	7.02	7.06	7.30	7.42	7.34
Office - Small................	6.16	6.19	6.22	6.25	6.28	6.32	6.36	6.58	6.71	6.65
Mercantile/Service............	13.59	13.73	13.85	13.96	14.09	14.23	14.36	14.96	15.52	15.75
Warehouse.....................	12.60	12.78	12.95	13.10	13.26	13.43	13.59	14.24	14.79	14.94
Other.........................	9.71	9.95	10.19	10.42	10.64	10.85	11.07	11.99	12.72	13.15
Total.......................	73.98	74.90	75.72	76.51	77.34	78.19	79.02	82.82	85.82	86.80
Equip.Coefficients of Perform.2/										
Space Heating										
Electricity.................	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.02	1.01
Natural Gas.................	0.72	0.72	0.72	0.72	0.72	0.73	0.73	0.74	0.74	0.75
Distillate..................	0.70	0.70	0.70	0.71	0.71	0.71	0.71	0.72	0.73	0.73
Space Cooling										
Electricity.................	2.49	2.52	2.56	2.58	2.61	2.64	2.66	2.77	2.85	2.91
Natural Gas.................	1.12	1.14	1.17	1.19	1.21	1.24	1.26	1.34	1.41	1.45
Water Heating										
Electricity.................	0.94	0.95	0.96	0.97	0.98	0.99	0.99	1.04	1.07	1.09
Natural Gas.................	0.69	0.70	0.71	0.72	0.72	0.73	0.73	0.76	0.77	0.78
Distillate..................	0.72	0.73	0.73	0.73	0.74	0.74	0.74	0.75	0.76	0.77
Ventilation 3/										
Electricity.................	0.40	0.40	0.40	0.40	0.41	0.41	0.41	0.42	0.44	0.45
Cooking										
Electricity.................	0.53	0.53	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
Natural Gas.................	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.48	0.48
Lighting Efficacy 4/										
(efficacy in lumens per watt)										
Electricity.................	53.80	54.36	54.93	55.53	56.14	56.72	57.19	59.28	60.47	61.33
Refrigeration										
Electricity.................	1.61	1.62	1.62	1.63	1.63	1.63	1.64	1.65	1.66	1.67

1/ Excludes commercial sector energy consumption (from uses such as street lights) that is not attributable to buildings.
2/ Unless noted otherwise, the efficiency measures are in the terms of coefficient of performance (COP). The COP is measured as Btu of energy output divided by Btu of purchased energy input.
3/ The efficiency measure for ventalation is in terms of cubic feet per minute of ventilation air delivered divided by Btu of purchased energy input.
4/ A measurement of the ratio of light produced by a light source to the electrical power used to produce that quality of light, expressed in lumens per watt.
Btu = British thermal unit.
Note: Totals may not equal sum of components due to independent rounding.
Source: EIA, AEO98 National Energy Modeling System run AEO98B.D100197A.

Table 23. Industrial Sector Macroeconomic Indicators

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
GDP (billion 1987 dollars)......	7489.1	7652.8	7814.8	7972.4	8130.4	8312.0	8503.5	9431.2	10210.7	10899.7
Non-Agricultural Employ. (mill.)	126.8	128.1	129.6	131.0	132.3	133.8	135.5	143.9	149.2	153.4
Value of Gross Output										
(billion 1987 dollars)										
Nonmanufacturing Sector										
Agricultural..................	243.0	246.3	250.5	254.9	257.3	260.5	264.3	281.2	292.3	301.3
Mining........................	140.3	140.2	141.8	142.8	144.1	145.1	146.6	153.5	155.6	156.9
Construction..................	441.5	448.4	456.7	463.1	467.7	475.6	486.3	534.2	570.9	603.4
Manufacturing Sector										
Food and Kindred Products......	409.6	416.2	422.5	429.2	435.3	442.0	449.2	482.9	507.1	525.9
Tobacco Products..............	26.4	26.0	25.5	25.1	24.6	24.3	24.0	22.1	19.8	17.5
Textile Mill Products..........	73.1	73.7	75.1	76.5	77.3	79.0	81.0	88.6	92.1	93.3
Apparel and Other Textile										
Products....................	65.7	65.0	65.6	66.4	66.2	67.1	68.1	71.0	69.2	63.8
Lumber and Wood Products.......	80.8	81.1	82.3	83.2	83.4	84.6	86.1	91.8	93.5	93.7
Furniture and Fixtures.........	45.2	45.9	47.0	47.9	48.0	48.3	48.6	51.5	51.6	50.5
Paper and Allied Products......	129.0	131.3	133.7	136.3	138.3	140.6	143.1	153.5	159.0	162.1
Printing and Publishing........	144.3	146.1	147.6	149.6	151.2	153.4	155.7	166.4	172.4	175.6
Chemical and Allied Products...	284.6	289.6	295.4	300.5	304.0	308.8	313.7	336.8	348.0	354.3
Bulk Chemicals..............	155.2	157.9	160.9	163.5	165.3	167.7	170.3	183.3	188.0	190.8
Other Chemicals and										
Allied Products...........	129.4	131.7	134.5	137.0	138.8	141.1	143.4	153.5	160.0	163.5
Petroleum and Coal Products....	158.9	161.1	163.3	166.8	168.7	171.6	173.6	179.6	184.0	187.3
Petroleum Refining...........	142.9	144.9	146.7	150.0	151.5	154.2	155.8	160.1	163.6	166.2
Other Petroleum and										
Coal Products.............	15.9	16.2	16.6	16.9	17.1	17.4	17.8	19.5	20.5	21.1
Rubber and Miscellaneous										
Plastic Products............	132.4	137.1	142.0	147.1	151.9	157.7	164.0	194.2	214.7	233.8
Leather and Leather Products...	5.4	5.2	5.3	5.3	5.0	4.9	4.8	4.2	3.0	1.5
Stone, Clay, and Glass Products	65.8	66.3	67.4	68.2	68.6	69.5	70.6	74.7	75.5	75.1
Glass and Glass Products.....	17.5	17.6	17.9	18.1	18.3	18.7	19.0	20.5	21.1	21.3
Cement, Hydraulic...........	4.6	4.6	4.7	4.7	4.7	4.7	4.7	4.9	4.8	4.7
Other Stone, Clay, and										
Glass Products............	43.7	44.1	44.9	45.4	45.5	46.1	46.9	49.3	49.7	49.2
Primary Metals Industry........	149.5	149.6	151.6	154.3	154.2	155.2	156.1	161.5	160.7	160.5
Blast Furnace and Basic										
Steel Products............	70.7	69.8	70.6	72.6	72.1	72.2	72.3	74.0	73.8	74.1
Aluminum....................	28.4	28.8	29.2	29.6	29.8	30.0	30.2	31.0	30.8	30.5
Other Primary Metal Products.	50.4	50.9	51.8	52.2	52.3	52.9	53.6	56.5	56.0	55.9
Fabricated Metal Products......	181.7	185.1	189.0	192.3	195.3	199.2	203.5	221.4	229.5	235.7
Industrial Machinery and										
Equipment...................	350.5	363.5	379.0	394.8	408.0	422.5	439.0	509.5	571.4	650.1
Electronic and Other Electric										
Equipment...................	348.1	370.2	392.4	414.4	444.8	481.9	523.4	729.4	867.1	1017.6
Transportation Equipment.......	423.5	436.0	444.8	452.3	469.2	488.9	500.7	558.4	591.3	610.8
Instruments & Related Products.	128.7	133.3	137.7	140.9	144.0	147.4	151.8	175.0	190.7	205.3
Miscellaneous Manufacturing										
Industries..................	41.9	42.0	42.5	42.9	42.8	43.1	43.6	46.0	45.6	42.9
Total Industrial Gross Output..	4069.9	4159.3	4258.7	4354.8	4449.7	4571.2	4697.7	5287.3	5665.0	6018.8

GDP = Gross domestic product.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1995 and 1996: Data Resources Incorporated (DRI), DRI Trend0897. Projections: Energy Information Administration, AEO98 National Energy Modeling System run AEO98B.D100197A.

Table 24. Refining Industry Energy Consumption

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Industry Output(billion 87 $)	142.91	144.88	146.74	149.96	151.54	154.17	155.79	160.10	163.55	166.18
Energy Consumption(trill. Btu)										
Residual Oil..................	36.0	37.2	37.5	11.8	11.5	11.5	11.9	13.4	13.7	44.2
Distillate Oil................	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Liquefied Petroleum Gas........	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.4	1.9	2.4
Petroleum Coke................	543.6	508.7	515.6	514.4	513.1	507.0	509.7	520.7	528.7	531.4
Still Gas.....................	1667.7	1716.3	1741.8	1783.2	1792.7	1814.1	1847.8	1923.7	2018.5	1971.4
Other Petroleum 2/............	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Petroleum Subtotal...........	2247.3	2262.2	2294.9	2309.4	2317.2	2332.6	2369.5	2459.1	2562.7	2549.3
Natural Gas 3/................	921.7	1016.0	1022.8	1065.7	1082.5	1106.9	1095.9	1080.1	1035.2	1029.7
Steam Coal....................	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Purchased Electricity..........	144.4	155.4	158.8	166.8	170.5	176.3	181.6	198.6	207.7	214.4
Total.......................	3313.4	3433.6	3476.4	3541.9	3570.2	3615.7	3646.9	3737.8	3805.6	3793.4
Energy Consumption per Unit of										
Output (thousand Btu/87$output)										
Residual Oil..................	0.25	0.26	0.26	0.08	0.08	0.07	0.08	0.08	0.08	0.27
Distillate Oil................	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liquefied Petroleum Gas........	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Petroleum Coke................	3.80	3.51	3.51	3.43	3.39	3.29	3.27	3.25	3.23	3.20
Still Gas.....................	11.67	11.85	11.87	11.89	11.83	11.77	11.86	12.02	12.34	11.86
Other Petroleum 2/............	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Petroleum Subtotal...........	15.73	15.61	15.64	15.40	15.29	15.13	15.21	15.36	15.67	15.34
Natural Gas 3/................	6.45	7.01	6.97	7.11	7.14	7.18	7.03	6.75	6.33	6.20
Steam Coal....................	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Purchased Electricity..........	1.01	1.07	1.08	1.11	1.12	1.14	1.17	1.24	1.27	1.29
Total.......................	23.19	23.70	23.69	23.62	23.56	23.45	23.41	23.35	23.27	22.83

1/ Fuel consumption includes consumption for cogeneration.
2/ Includes lubricants and miscellaneous petroleum products.
3/ Does not include lease and plant fuel.
Btu = British thermal unit.
N/A = Not applicable.
Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, AEO98 National Energy Modeling System run AEO98B.D100197A.

Table 25. Food Industry Energy Consumption

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Industry Output(billion 87 $)	409.61	416.19	422.49	429.21	435.26	441.96	449.22	482.91	507.09	525.92
Energy Consumption(trill. Btu)										
Residual Oil..................	28.2	28.3	28.5	28.8	28.9	29.1	29.4	30.5	31.0	31.1
Distillate Oil................	11.2	11.3	11.3	11.4	11.4	11.5	11.6	12.0	12.2	12.3
Liquefied Petroleum Gas........	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.3	3.4	3.5
Other Petroleum 2/............	65.6	65.5	65.6	66.0	65.5	66.0	66.3	68.1	68.9	68.7
Petroleum Subtotal...........	108.2	108.3	108.7	109.4	109.0	109.8	110.5	114.0	115.5	115.6
Natural Gas 3/................	537.0	542.4	545.1	550.7	555.6	560.5	565.5	584.5	592.6	592.6
Steam Coal....................	181.7	183.3	186.1	188.1	190.2	192.3	195.1	206.8	212.5	216.8
Renewables....................	40.9	41.4	42.0	42.5	43.1	43.7	44.4	47.8	49.5	51.0
Purchased Electricity..........	171.0	173.9	177.3	179.2	181.3	183.7	186.4	199.4	209.4	217.6
Total.......................	1038.7	1049.2	1059.3	1070.0	1079.2	1089.9	1101.8	1152.6	1179.6	1193.7
Energy Consumption per Unit of										
Output (thousand Btu/87$output)										
Residual Oil..................	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06
Distillate Oil................	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02
Liquefied Petroleum Gas........	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Other Petroleum 2/............	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.13
Petroleum Subtotal...........	0.26	0.26	0.26	0.25	0.25	0.25	0.25	0.24	0.23	0.22
Natural Gas 3/................	1.31	1.30	1.29	1.28	1.28	1.27	1.26	1.21	1.17	1.13
Steam Coal....................	0.44	0.44	0.44	0.44	0.44	0.44	0.43	0.43	0.42	0.41
Renewables....................	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Purchased Electricity..........	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.41	0.41	0.41
Total.......................	2.54	2.52	2.51	2.49	2.48	2.47	2.45	2.39	2.33	2.27

1/ Fuel consumption includes consumption for cogeneration.
2/ Includes petroleum coke, lubricants, and miscellaneous petroleum products.
3/ Does not include lease and plant fuel.
Btu = British thermal unit.
N/A = Not applicable.
Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, AEO98 National Energy Modeling System run AEO98B.D100197A.

Table 26. Paper Industry Energy Consumption

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Industry Output(billion 87 $)	128.95	131.30	133.73	136.30	138.29	140.58	143.05	153.45	158.98	162.07
Energy Consumption(trill. Btu)										
Residual Oil..................	170.0	168.0	166.1	164.8	162.5	161.1	159.6	150.5	138.2	125.0
Distillate Oil................	5.0	5.0	4.9	4.9	4.8	4.8	4.7	4.5	4.1	3.7
Liquefied Petroleum Gas........	1.3	1.3	1.3	1.3	1.2	1.2	1.2	1.2	1.1	1.0
Other Petroleum 2/............	25.0	24.8	24.6	24.5	24.2	24.0	23.8	22.6	21.0	19.1
Petroleum Subtotal...........	201.4	199.1	197.0	195.4	192.7	191.1	189.4	178.8	164.3	148.8
Natural Gas 3/................	540.3	538.1	534.4	531.8	528.0	524.5	520.8	494.8	460.0	418.8
Steam Coal....................	383.0	381.1	380.9	379.9	378.2	376.5	375.8	365.9	345.2	321.0
Renewables....................	1297.4	1313.2	1329.5	1347.3	1360.2	1376.0	1393.4	1465.5	1498.4	1512.3
Purchased Electricity..........	205.9	207.7	209.8	211.7	213.0	214.6	216.5	223.5	224.2	222.0
Total.......................	2628.0	2639.3	2651.5	2666.1	2672.2	2682.7	2695.9	2728.4	2692.1	2622.9
Energy Consumption per Unit of										
Output (thousand Btu/87$output)										
Residual Oil..................	1.32	1.28	1.24	1.21	1.17	1.15	1.12	0.98	0.87	0.77
Distillate Oil................	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.02
Liquefied Petroleum Gas........	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Other Petroleum 2/............	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.15	0.13	0.12
Petroleum Subtotal...........	1.56	1.52	1.47	1.43	1.39	1.36	1.32	1.16	1.03	0.92
Natural Gas 3/................	4.19	4.10	4.00	3.90	3.82	3.73	3.64	3.22	2.89	2.58
Steam Coal....................	2.97	2.90	2.85	2.79	2.73	2.68	2.63	2.38	2.17	1.98
Renewables....................	10.06	10.00	9.94	9.88	9.84	9.79	9.74	9.55	9.43	9.33
Purchased Electricity..........	1.60	1.58	1.57	1.55	1.54	1.53	1.51	1.46	1.41	1.37
Total.......................	20.38	20.10	19.83	19.56	19.32	19.08	18.85	17.78	16.93	16.18

1/ Fuel consumption includes consumption for cogeneration.
2/ Includes petroleum coke, lubricants, and miscellaneous petroleum products.
3/ Does not include lease and plant fuel.
Btu = British thermal unit.
N/A = Not applicable.
Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, AEO98 National Energy Modeling System run AEO98B.D100197A.

Table 27. Bulk Chemical Industry Energy Consumption

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Industry Output(billion 87 $)	155.23	157.91	160.90	163.49	165.29	167.66	170.30	183.33	188.00	190.78
Energy Consumption(trillion Btu)										
Heat and Power										
Residual Oil................	34.2	34.4	34.4	34.6	34.4	34.6	34.6	35.0	34.2	33.0
Distillate Oil.............	9.9	9.9	10.0	10.1	10.1	10.1	10.1	10.5	10.4	10.2
Liquefied Petroleum Gas.....	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.4	3.5	3.5
Other Petroleum 2/..........	199.7	201.4	203.8	205.7	206.5	208.1	209.8	218.7	218.6	215.8
Petroleum Subtotal........	247.1	248.9	251.5	253.6	254.2	256.0	257.8	267.6	266.6	262.5
Natural Gas 3/.............	1647.3	1663.6	1680.2	1695.2	1702.9	1715.1	1729.1	1786.0	1766.2	1726.6
Steam Coal.................	231.1	233.5	237.0	239.6	241.3	243.8	246.9	262.5	264.9	266.4
Renewables.................	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Purchased Electricity.......	312.6	318.3	325.4	329.9	333.1	337.7	342.9	374.7	393.8	407.8
Total Heat and Power........	2438.1	2464.3	2494.2	2518.4	2531.5	2552.5	2576.7	2690.8	2691.5	2663.3
Feedstock										
Liquefied Petroleum Gas.....	1693.8	1720.4	1740.4	1763.9	1779.9	1801.5	1825.5	1943.8	1981.6	1999.8
Petrochemical Feedstocks....	824.7	837.8	847.6	859.1	867.0	877.5	889.3	947.0	965.3	973.8
Petroleum Subtotal........	2518.4	2558.2	2588.0	2623.0	2646.8	2679.1	2714.8	2890.9	2947.0	2973.6
Natural Gas 3/.............	646.5	659.9	650.8	660.1	666.8	675.4	684.9	730.9	748.8	759.6
Total Feedstocks..........	3164.9	3218.1	3238.8	3283.1	3313.6	3354.5	3399.7	3621.8	3695.8	3733.2
Total........................	5603.1	5682.3	5733.0	5801.5	5845.2	5907.0	5976.4	6312.6	6387.2	6396.5
Consumption per Unit of Output										
(thousand Btu/87$output)										
Heat and Power										
Residual Oil................	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Distillate Oil.............	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Liquefied Petroleum Gas.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Petroleum 3/..........	1.3	1.3	1.3	1.3	1.2	1.2	1.2	1.2	1.2	1.1
Petroleum Subtotal........	1.6	1.6	1.6	1.6	1.5	1.5	1.5	1.5	1.4	1.4
Natural Gas 2/.............	10.6	10.5	10.4	10.4	10.3	10.2	10.2	9.7	9.4	9.1
Steam Coal.................	1.5	1.5	1.5	1.5	1.5	1.5	1.4	1.4	1.4	1.4
Renewables.................	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Purchased Electricity.......	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.1
Total Heat and Power......	15.7	15.6	15.5	15.4	15.3	15.2	15.1	14.7	14.3	14.0
Feedstock										
Liquefied Petroleum Gas.....	10.9	10.9	10.8	10.8	10.8	10.7	10.7	10.6	10.5	10.5
Petrochemical Feedstocks....	5.3	5.3	5.3	5.3	5.2	5.2	5.2	5.2	5.1	5.1
Petroleum Subtotal........	16.2	16.2	16.1	16.0	16.0	16.0	15.9	15.8	15.7	15.6
Natural Gas 2/.............	4.2	4.2	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Total Feedstocks..........	20.4	20.4	20.1	20.1	20.0	20.0	20.0	19.8	19.7	19.6
Total........................	36.1	36.0	35.6	35.5	35.4	35.2	35.1	34.4	34.0	33.5

1/ Fuel consumption includes consumption for cogeneration.
2/ Includes petroleum coke, lubricants, and miscellaneous petroleum products.
3/ Does not include lease and plant fuel.
Btu = British thermal unit.
N/A = Not applicable.
Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, AEO98 National Energy Modeling System run AEO98B.D100197A.

Table 28. Glass Industry Energy Consumption

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Industry Output(billion 87 $)	17.50	17.60	17.86	18.11	18.35	18.65	19.00	20.54	21.05	21.30
Energy Consumption(trill. Btu)										
Residual Oil..................	4.0	4.1	4.0	4.0	3.8	3.8	3.8	3.6	3.4	3.2
Distillate Oil................	2.9	2.8	2.8	2.8	2.7	2.7	2.6	2.6	2.4	2.3
Liquefied Petroleum Gas........	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Other Petroleum 2/............	2.0	2.0	2.0	1.9	1.9	1.9	1.8	1.7	1.6	1.5
Petroleum Subtotal...........	9.0	8.9	8.8	8.8	8.5	8.5	8.4	8.0	7.5	7.1
Natural Gas 3/................	212.6	211.1	210.7	211.0	211.1	211.5	212.1	212.6	203.8	192.7
Steam Coal....................	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.4	1.4	1.4
Renewables....................	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Purchased Electricity..........	58.4	58.8	59.9	60.2	60.5	61.1	61.9	65.3	66.8	67.6
Total.......................	281.3	280.1	280.7	281.2	281.4	282.4	283.7	287.3	279.5	268.7
Energy Consumption per Unit of										
Output (thousand Btu/87$output)										
Residual Oil..................	0.23	0.23	0.22	0.22	0.21	0.20	0.20	0.18	0.16	0.15
Distillate Oil................	0.16	0.16	0.16	0.15	0.15	0.14	0.14	0.12	0.11	0.11
Liquefied Petroleum Gas........	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
Other Petroleum 2/............	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.08	0.08	0.07
Petroleum Subtotal...........	0.51	0.51	0.49	0.48	0.46	0.45	0.44	0.39	0.36	0.33
Natural Gas 3/................	12.15	11.99	11.80	11.65	11.51	11.34	11.16	10.35	9.68	9.05
Steam Coal....................	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06
Renewables....................	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Purchased Electricity..........	3.34	3.34	3.35	3.32	3.30	3.28	3.26	3.18	3.17	3.17
Total.......................	16.07	15.92	15.72	15.53	15.34	15.14	14.93	13.99	13.28	12.62

1/ Fuel consumption includes consumption for cogeneration.
2/ Includes petroleum coke, lubricants, and miscellaneous petroleum products.
3/ Does not include lease and plant fuel.
Btu = British thermal unit.
N/A = Not applicable.
Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, AEO98 National Energy Modeling System run AEO98B.D100197A.

Table 29. Cement Industry Energy Consumption

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Industry Output(billion 87 $)	4.59	4.60	4.66	4.71	4.69	4.69	4.73	4.87	4.81	4.65
Energy Consumption(trill. Btu)										
Residual Oil..................	1.1	1.1	1.1	1.1	1.0	1.0	1.0	0.9	0.8	0.7
Distillate Oil................	1.2	1.1	1.1	1.1	1.1	1.0	1.0	0.9	0.9	0.8
Liquefied Petroleum Gas........	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Petroleum 2/............	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Petroleum Subtotal...........	2.3	2.2	2.2	2.1	2.1	2.0	2.0	1.8	1.7	1.5
Natural Gas 3/................	48.8	48.3	47.9	47.7	46.9	46.5	46.2	43.2	40.1	36.0
Steam Coal....................	268.7	267.6	268.5	268.4	266.4	265.0	264.7	263.2	253.1	241.6
Renewables....................	5.8	5.8	5.8	5.8	5.7	5.7	5.7	5.6	5.3	5.0
Purchased Electricity..........	38.1	38.3	38.8	39.0	38.7	38.8	39.0	40.0	39.9	38.6
Total.......................	363.7	362.2	363.1	363.0	359.8	358.0	357.6	353.7	340.1	322.6
Energy Consumption per Unit of										
Output (thousand Btu/87$output)										
Residual Oil..................	0.25	0.24	0.23	0.23	0.22	0.21	0.21	0.18	0.16	0.15
Distillate Oil................	0.25	0.24	0.24	0.23	0.22	0.22	0.21	0.19	0.18	0.17
Liquefied Petroleum Gas........	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Petroleum 2/............	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Petroleum Subtotal...........	0.50	0.48	0.47	0.46	0.44	0.43	0.42	0.38	0.35	0.32
Natural Gas 3/................	10.62	10.49	10.26	10.13	10.01	9.91	9.77	8.87	8.35	7.74
Steam Coal....................	58.54	58.13	57.57	57.03	56.85	56.47	55.97	53.99	52.66	51.95
Renewables....................	1.27	1.26	1.24	1.23	1.22	1.21	1.20	1.14	1.11	1.08
Purchased Electricity..........	8.30	8.32	8.31	8.28	8.27	8.26	8.25	8.20	8.30	8.30
Total.......................	79.23	78.69	77.85	77.13	76.79	76.29	75.60	72.57	70.76	69.38

1/ Fuel consumption includes consumption for cogeneration.
2/ Includes petroleum coke, lubricants, and miscellaneous petroleum products.
3/ Does not include lease and plant fuel.
Btu = British thermal unit.
N/A = Not applicable.
Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, AEO98 National Energy Modeling System run AEO98B.D100197A.

Table 30. Iron and Steel Industries Energy Consumption

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Industry Output(billion 87 $)	70.71	69.84	70.62	72.60	72.07	72.20	72.30	74.04	73.82	74.06
Energy Consumption(trill. Btu)										
Residual Oil..................	73.5	72.0	72.1	72.5	71.2	70.6	69.8	66.5	63.1	59.8
Distillate Oil................	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Liquefied Petroleum Gas........	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Petroleum 2/............	17.2	17.0	16.9	16.9	16.7	16.6	16.4	15.9	15.2	14.6
Petroleum Subtotal...........	90.6	88.9	89.0	89.4	87.9	87.1	86.2	82.4	78.3	74.5
Natural Gas 3/................	602.6	594.7	594.2	605.6	601.7	600.9	600.2	604.1	594.1	585.5
Metallurgical Coal 4/..........	1000.2	988.3	987.9	995.7	986.6	982.0	977.4	962.8	936.5	915.0
Steam Coal....................	84.2	83.3	86.4	92.1	92.1	93.8	95.7	111.8	123.5	143.4
Coal Subtotal................	1084.3	1071.6	1074.3	1087.8	1078.6	1075.8	1073.1	1074.6	1059.9	1058.4
Blast Furnace and Coke Oven Gas	246.0	242.1	239.5	237.8	234.3	231.3	228.3	213.7	198.4	183.4
Purchased Electricity..........	205.3	203.5	207.6	212.1	209.8	210.1	210.3	215.4	218.2	222.6
Total.......................	2228.8	2200.7	2204.7	2232.8	2212.4	2205.2	2198.0	2190.2	2148.9	2124.4
Energy Consumption per Unit of										
Output (thousand Btu/87$output)										
Residual Oil..................	1.04	1.03	1.02	1.00	0.99	0.98	0.96	0.90	0.85	0.81
Distillate Oil................	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liquefied Petroleum Gas........	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Petroleum 2/............	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.21	0.21	0.20
Petroleum Subtotal...........	1.28	1.27	1.26	1.23	1.22	1.21	1.19	1.11	1.06	1.01
Natural Gas 3/................	8.52	8.51	8.41	8.34	8.35	8.32	8.30	8.16	8.05	7.91
Metallurgical Coal 4/..........	14.14	14.15	13.99	13.71	13.69	13.60	13.52	13.00	12.69	12.35
Steam Coal....................	1.19	1.19	1.22	1.27	1.28	1.30	1.32	1.51	1.67	1.94
Coal Subtotal................	15.34	15.34	15.21	14.98	14.97	14.90	14.84	14.51	14.36	14.29
Blast Furnace and Coke Oven Gas	3.48	3.47	3.39	3.28	3.25	3.20	3.16	2.89	2.69	2.48
Purchased Electricity..........	2.90	2.91	2.94	2.92	2.91	2.91	2.91	2.91	2.96	3.01
Total.......................	31.52	31.51	31.22	30.75	30.70	30.54	30.40	29.58	29.11	28.68

1/ Fuel consumption includes consumption for cogeneration.
2/ Includes petroleum coke, lubricants, and miscellaneous petroleum products.
3/ Does not include lease and plant fuel.
Btu = British thermal unit.
N/A = Not applicable.
Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, AEO98 National Energy Modeling System run AEO98B.D100197A.

Table 31. Aluminum Industry Energy Consumption

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Industry Output(billion 87 $)	28.42	28.78	29.22	29.55	29.82	30.04	30.18	30.98	30.80	30.49
Energy Consumption(trill. Btu)										
Residual Oil..................	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Distillate Oil................	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Liquefied Petroleum Gas........	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Petroleum 2/............	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Petroleum Subtotal...........	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural Gas 3/................	31.1	31.3	31.5	31.6	31.7	31.7	31.7	31.7	30.7	29.7
Steam Coal....................	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables....................	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Purchased Electricity..........	245.2	246.9	249.2	250.7	251.7	252.4	252.4	253.4	247.2	240.4
Total.......................	276.3	278.1	280.7	282.4	283.4	284.1	284.1	285.1	278.0	270.1
Energy Consumption per Unit of										
Output (thousand Btu/87$output)										
Residual Oil..................	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Distillate Oil................	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liquefied Petroleum Gas........	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Petroleum 2/............	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Petroleum Subtotal...........	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas 3/................	1.09	1.09	1.08	1.07	1.06	1.06	1.05	1.02	1.00	0.97
Steam Coal....................	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewables....................	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Purchased Electricity..........	8.63	8.58	8.53	8.48	8.44	8.40	8.36	8.18	8.03	7.89
Total.......................	9.72	9.66	9.61	9.55	9.50	9.46	9.41	9.20	9.02	8.86

1/ Fuel consumption includes consumption for cogeneration.
2/ Includes petroleum coke, lubricants, and miscellaneous petroleum products.
3/ Does not include lease and plant fuel.
Btu = British thermal unit.
N/A = Not applicable.
Note: Totals may not equal sum of components due to independent rounding.
Source: Energy Information Administration, AEO98 National Energy Modeling System run AEO98B.D100197A.

Table 46. Light-Duty Vehicle MPG by Technology Type (MPG Gasoline Equivalents)

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Automobiles 1/										
Conventional Vehicles										
Gasoline ICE Vehicles..........	27.65	27.93	28.18	28.43	28.66	28.99	29.09	29.63	29.84	30.10
Distillate (diesel) ICE........	29.64	29.93	30.21	30.48	30.81	29.48	29.57	30.12	30.25	30.39
Alternative-Fuel Vehicles										
Alcohol Fuel Technology										
Methanol-Flex Fuel ICE.......	29.18	29.47	29.72	29.97	30.29	29.37	29.56	30.17	30.37	30.61
Methanol-Neat ICE............	29.25	29.47	29.66	29.90	30.20	30.64	30.78	31.33	31.45	31.57
Ethanol-Flex Fuel ICE........	28.96	29.24	29.49	29.74	30.05	29.16	29.35	29.96	30.16	30.37
Ethanol-Neat Ice.............	28.04	28.27	28.47	28.72	29.03	29.38	29.52	30.13	30.31	30.50
Natural Gas Technology										
Compressed Natural Gas ICE...	27.55	27.73	27.89	28.10	28.36	28.50	28.51	28.62	28.95	28.82
Compress. Natural Gas Bi-fuel	25.60	25.77	25.92	26.13	26.36	26.50	26.51	26.68	26.98	26.88
Liquid Petroleum Gas ICE.....	28.03	28.24	28.39	28.56	28.76	28.81	28.84	28.93	29.15	29.21
Liquid Petroleum Gas Bi-fuel.	26.65	26.86	27.04	27.24	27.45	26.94	26.96	27.13	27.41	27.36
Electric Technology										
Electric Vehicle.............	32.13	32.14	32.09	32.10	35.08	38.42	42.84	56.34	57.68	58.82
Electric Hybrid..............	41.32	41.66	41.86	42.26	42.58	42.44	42.15	41.26	40.87	41.96
Turbine Technology										
Gas Turbine Gasoline.........	33.22	33.55	33.86	34.19	34.55	33.73	33.84	34.32	34.27	34.24
Gas Turbine CNG..............	33.21	33.53	33.84	34.18	34.54	33.71	33.82	34.31	34.26	34.22
Fuel Cell Technology										
Fuel Cell Methanol...........	47.42	47.46	47.44	47.51	47.59	45.90	44.88	44.77	45.30	46.45
Fuel Cell Hydrogen...........	51.72	51.78	51.76	51.84	51.93	49.82	49.08	49.17	49.83	51.07
Average New Car MPG............	27.68	27.95	28.22	28.46	28.87	29.31	29.51	30.25	30.46	30.73
Light-Duty Trucks 1/										
Conventional Vehicles										
Gasoline ICE Vehicles..........	19.10	19.25	19.37	19.44	19.53	19.72	19.74	20.00	20.43	21.00
Distillate (diesel) ICE........	19.84	19.98	20.08	20.13	20.23	20.34	20.34	20.59	21.07	21.66
Alternative-Fuel Vehicles										
Alcohol Fuel Technology										
Methanol-Flex Fuel ICE.......	19.59	19.74	19.83	19.90	20.04	19.04	19.05	19.32	19.74	20.28
Methanol-Neat ICE............	23.49	23.63	23.72	23.78	23.94	24.02	23.96	24.10	24.52	25.05
Ethanol-Flex Fuel ICE........	19.39	19.55	19.64	19.71	19.84	18.95	18.96	19.24	19.67	20.18
Ethanol-Neat Ice.............	22.05	22.20	22.29	22.36	22.52	22.59	22.55	22.76	23.19	23.72
Natural Gas Technology										
Compressed Natural Gas ICE...	19.55	19.65	19.72	19.78	19.88	19.94	19.95	20.08	20.36	20.89
Compress. Natural Gas Bi-fuel	18.04	18.17	18.24	18.28	18.36	18.14	18.16	18.35	18.65	19.17
Liquid Petroleum Gas ICE.....	18.75	18.81	18.86	18.92	19.09	19.23	19.26	19.44	19.74	20.27
Liquid Petorleum Gas Bi-fuel.	18.70	18.83	18.91	18.95	19.04	18.71	18.71	18.85	19.15	19.69
Electric Technology										
Electric Vehicle.............	25.13	25.16	25.14	25.20	27.60	30.27	33.68	43.69	44.16	45.17
Electric Hybrid..............	28.85	29.13	29.29	29.63	29.80	28.16	27.94	27.39	27.14	27.89
Turbine Technology										
Gas Turbine Gasoline.........	18.67	18.88	19.09	19.32	19.60	19.52	19.66	20.61	21.77	22.36
Gas Turbine CNG..............	18.67	18.87	19.07	19.28	19.55	19.51	19.64	20.54	21.65	22.25
Fuel Cell Technology										
Fuel Cell Methanol...........	49.89	49.89	49.78	49.79	49.83	49.33	46.92	42.85	41.15	42.12
Fuel Cell Hydrogen...........	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average New Truck MPG...........	19.10	19.26	19.38	19.45	19.61	19.75	19.78	20.06	20.49	21.06
Fleet Average Stock Car MPG 2/..	22.56	22.62	22.67	22.73	22.81	22.91	23.03	23.57	24.20	24.71
Fleet Average Stock Truck MPG 2/	16.16	16.05	15.94	15.85	15.77	15.73	15.69	15.69	15.94	16.29
Fleet Aver. Stock Vehicle MPG 2/	20.35	20.31	20.26	20.22	20.19	20.18	20.18	20.33	20.74	21.19

Table 46. Light-Duty Vehicle MPG by Technology Type (MPG Gasoline Equivalents)										
	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020

Table 50. Light-Duty Vehicle MPG by Technology Type (MPG Gasoline Equivalents)

1/ Fuel efficiencies are EPA rated. Includes personal and fleet vehicles.

2/ Stock values are on road efficiencies. Includes personal vehicles, fleet vehicles, and freight light trucks.

MPG = Miles per Gallon.

ICE = Internal combustion engine.

Sources: 1996 derived using: Decision Analysis Corporation of Virginia and Energy Environmental Analysis Incorporated, NEMS Transportation Sector Model: Alternative-Fuel Vehicle Fuel Economy Module, Final Report, Subtask 12-3, prepared for Energy Information Administration (EIA), October 30, 1995; Decision Analysis Corporation of Virginia, Characteristics Update of Alternative-Fuel Light-Duty Vehicles, Final Report, Subtask 6-4, prepared for EIA (November 30, 1994); National Highway Traffic and Safety Administration, Mid-Model Year Fuel Economy Reports from Auto Manufacturers, 1997; Federal Highway Administration, Highway Statistics 1995, (November 1996); United States Department of Commerce, Bureau of the Census, Truck Inventory and Use Survey, TC92-T-52 (Washington, DC, May 1995);and EIA, AEO98 National Energy Modeling System run AEO98B.D100197A. Projections: EIA, AEO98 National Energy Modeling System run AEO98B.D100197A.

Table 71. Electric Power and Projections for the U.S.

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Electricity Generating Cap.1/										
(gigawatts)										
Coal Steam....................	298.73	296.78	299.10	296.40	299.22	300.61	302.14	304.62	316.04	323.58
Other Fossil Steam 2/.........	127.99	121.27	116.81	112.67	106.40	105.30	103.61	100.96	97.14	96.02
Combined Cycle................	16.59	27.67	31.88	41.61	49.77	65.36	71.33	106.50	154.94	186.52
Combustion Turbine/Diesel.....	137.42	140.37	144.20	146.58	165.23	170.67	176.16	191.39	210.09	221.90
Nuclear Power.................	96.98	95.57	94.79	92.59	91.18	89.34	86.76	80.38	63.90	49.24
Pumped Storage/Other 3/.......	19.85	19.85	19.85	19.85	19.85	19.85	19.85	19.85	19.85	19.85
Fuel Cells....................	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewable 4/..................	91.11	91.29	91.84	92.11	92.32	92.56	92.86	93.64	94.69	95.70
Total Capability.............	788.69	792.80	798.50	801.80	823.97	843.69	852.72	897.34	956.66	992.81
Cumulative Planned Additions 5/										
Coal Steam....................	2.35	3.15	3.15	3.15	3.15	3.15	3.15	4.75	4.75	4.75
Other Fossil Steam 2/.........	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Combined Cycle................	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.95	2.95	2.95
Combustion Turbine/Diesel.....	5.23	5.23	5.23	5.23	5.23	5.23	5.23	5.23	5.23	5.23
Nuclear Power.................	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17
Pumped Storage/Other 3/.......	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Fuel Cells....................	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewable 4/..................	2.79	2.86	2.93	3.08	3.08	3.08	3.08	3.18	3.18	3.18
Total (planned).............	15.46	16.34	16.41	16.56	16.56	16.56	16.56	18.51	18.51	18.51
Cumulative Unplanned Addit. 5/										
Coal Steam....................	0.00	0.00	4.63	5.98	9.70	11.53	13.27	16.85	32.13	45.37
Other Fossil Steam 2/.........	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Combined Cycle................	0.00	11.08	15.29	25.02	33.18	48.78	54.74	89.66	138.10	169.68
Combustion Turbine/Diesel.....	79.65	82.68	86.71	89.26	108.07	113.53	119.09	134.65	154.48	166.28
Nuclear Power.................	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pumped Storage/Other 3/.......	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fuel Cells....................	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewable 4/..................	0.61	0.65	1.12	1.26	1.44	1.74	1.98	2.82	4.16	5.35
Total (unplanned)............	80.26	94.42	107.75	121.51	152.39	175.57	189.08	243.98	328.87	386.69
Cumulative Total Additions...	11.48	12.28	12.28	12.28	12.28	12.28	12.28	14.13	14.13	14.13
Cumulative Retirements.........	34.95	45.94	52.34	63.18	72.01	75.54	80.07	92.35	117.10	138.77
Cogenerators 6/										
Capacity										
Coal..........................	7.10	7.13	7.17	7.21	7.24	7.27	7.32	7.48	7.50	7.48
Petroleum.....................	1.14	1.15	1.15	1.16	1.17	1.18	1.19	1.23	1.24	1.24
Natural Gas...................	30.27	30.45	30.71	30.96	31.13	31.33	31.57	32.74	32.71	31.88
Other Gaseous Fuels...........	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.14	1.14	1.14
Renewables....................	6.33	6.36	6.39	6.42	6.44	6.47	6.50	6.61	6.56	6.43
Other.........................	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total........................	45.96	46.21	46.55	46.89	47.11	47.38	47.71	49.19	49.15	48.17
Electricity Demand										
(billion kilowatthours)										
Residential.....................	1125.92	1159.55	1193.71	1209.19	1224.49	1238.09	1256.76	1349.09	1447.69	1542.10
Commercial/Other................	1037.52	1052.20	1066.33	1079.64	1093.63	1108.60	1124.14	1198.59	1267.10	1303.29
Industrial......................	1070.30	1081.80	1105.94	1126.23	1141.98	1164.63	1185.18	1280.58	1341.60	1390.68
Transportation..................	16.83	17.31	18.15	19.00	23.24	27.15	30.66	44.32	53.81	61.88
Total Sales....................	3250.57	3310.85	3384.14	3434.05	3483.33	3538.47	3596.74	3872.58	4110.20	4297.95
Net Energy for Load (bil.kwh) 7/										
Gross International Imports....	52.42	54.17	53.20	53.58	55.34	55.28	53.44	51.36	47.86	47.86
Gross International Exports....	15.14	14.74	14.85	14.96	20.10	20.22	20.34	21.01	21.01	21.01
Gross Interregional Elec. Imp..	242.87	222.38	212.57	209.15	214.04	208.03	205.61	215.97	217.32	224.09
Gross Interregional Elec. Exp..	244.56	223.87	213.98	210.50	215.53	209.39	206.96	217.53	218.91	225.82
Purchases from cogenerators 6/.	123.48	123.77	124.12	124.46	124.73	125.04	125.39	127.03	127.18	126.27
Generation by Utilities........	3205.76	3191.53	3198.81	3173.72	3100.44	3046.00	3044.40	3035.32	2862.63	2733.27
Total Net Energy for Load.....	3364.83	3353.24	3359.88	3335.45	3258.92	3204.75	3201.54	3191.13	3015.06	2884.66
Generation by Fuel Type										
(billion kilowatthours)										
Coal..........................	1876.10	1903.44	1950.81	1953.77	1967.58	1980.44	2007.13	2084.89	2189.82	2265.43
Petroleum.....................	60.47	53.94	51.64	49.22	38.92	35.11	36.75	35.39	32.67	31.79
Natural Gas....................	382.18	418.70	457.01	500.78	565.04	624.67	671.16	920.17	1170.65	1388.95
Nuclear........................	688.55	689.22	679.92	684.64	670.36	658.06	642.92	595.61	479.70	382.80
Pumped Storage/Other 3/........	-3.11	-3.11	-3.11	-3.11	-3.11	-3.11	-3.11	-3.11	-3.11	-3.11
Renewable 4/...................	366.09	369.60	371.66	373.03	374.17	375.21	377.06	382.03	387.84	393.50
Total Generation.............	3370.28	3431.80	3507.93	3558.33	3612.96	3670.37	3731.90	4014.98	4257.57	4459.35

Table 71. Electric Power and Projections for the U.S.

	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Sales to Customers............	3344.10	3405.61	3481.75	3532.15	3586.78	3644.19	3705.72	3988.80	4231.34	4433.12
Generation for Own Use.........	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.18	26.23	26.23
Cogenerators										
Coal..........................	36.84	37.00	37.21	37.45	37.57	37.76	37.98	38.82	38.89	38.68
Petroleum.....................	5.68	5.69	5.71	5.74	5.75	5.77	5.80	5.89	5.87	5.82
Natural Gas...................	182.17	183.62	185.55	187.30	188.62	190.11	191.88	200.69	200.41	193.83
Other Gaseous Fuels...........	6.98	6.99	7.00	7.00	7.01	7.02	7.03	7.07	7.09	7.09
Renewable.....................	41.62	41.81	42.01	42.23	42.32	42.49	42.70	43.29	42.89	42.01
Other.........................	3.24	3.27	3.31	3.33	3.35	3.38	3.40	3.53	3.52	3.48
Total........................	276.54	278.38	280.78	283.05	284.63	286.53	288.79	299.30	298.68	290.90
Sales to Utilities............	123.48	123.77	124.12	124.46	124.73	125.04	125.39	127.03	127.18	126.27
Generation for Own Use.........	153.05	154.62	156.66	158.59	159.90	161.50	163.40	172.26	171.50	164.63
End-Use Prices 8/										
(1996 cents per kilowatthour)										
Residential...................	7.9	7.8	7.7	7.6	7.6	7.6	7.5	7.3	7.0	6.8
Commercial....................	7.3	7.2	7.1	7.0	6.9	6.9	6.8	6.5	6.1	6.0
Industrial....................	4.4	4.3	4.3	4.2	4.2	4.1	4.1	3.9	3.6	3.5
Transportation................	5.1	5.0	4.9	4.8	4.8	4.7	4.7	4.5	4.3	4.2
All Sectors Average..........	6.6	6.5	6.4	6.3	6.3	6.2	6.1	5.9	5.6	5.5
Fuel Consumption (quad. Btu) 9/										
Coal..........................	19.23	19.57	20.04	20.05	20.17	20.29	20.55	21.34	22.29	22.99
Natural Gas...................	4.03	4.14	4.45	4.69	5.10	5.37	5.69	7.38	8.71	10.07
Oil...........................	0.61	0.54	0.52	0.49	0.39	0.35	0.37	0.35	0.32	0.31
Total........................	23.86	24.25	25.01	25.24	25.66	26.00	26.61	29.07	31.33	33.37
Emissions(million short tons)10/										
Total Carbon.................	574.10	583.03	599.41	603.68	610.34	616.67	629.57	676.77	734.41	777.41
Carbon Dioxide...............	2105.02	2137.74	2197.83	2213.46	2237.89	2261.10	2308.40	2481.46	2692.79	2850.45
Sulfur Dioxide...............	10.27	9.51	9.43	9.34	9.26	9.15	9.06	8.64	8.42	8.42
Nitrogen Oxide...............	7.34	5.57	5.69	5.66	5.63	5.62	5.70	5.91	6.13	6.34

Note: Totals may not equal sum of components due to independent rounding.

1/ Net summer capability is the steady hourly output that generating equipment is expected to supply to system load (exclusive of auxiliary power), as demonstrated by tests during summer peak demand. Includes electric utilities, small power producers, and exempt wholesale generators. Nameplate capacity is reported for nonutilities on Form EIA-867, "Annual Nonutility Power Producer Report." Nameplate capacity is designated by the manufacturer. The nameplate capacity has been converted to net summer capacity based on historic relationships.

2/ Includes oil-, gas-, and dual-fired capability.

3/ Other includes methane, propane gas, and blast furnace gas, hydrogen, sulfur, batteries, chemicals, fish oil, and spent sulfite liquor.

4/ Includes conventional hydroelectric, geothermal, wood, wood waste, municipal solid waste, other biomass, solar thermal, photovoltaics, and wind power.

5/ Cumulative additions after December 31, 1989.

6/ Cogenerators produce electricity and another form of useful energy (such as steam or heat) through the sequential use of energy.

7/ Generation to meet system load by source.

8/ Prices represent average revenue per kilowatthour.

9/ Includes fuel consumption by electric utilities, small power producers, independent power producers, and exempt wholesale generators.

10/ Estimated emissions from utilities and nonutilities (excluding cogenerators).

O&M = Operation and maintenance.

EMM = Electricity market module.

N/A = Not applicable.

Note: Totals may not equal sum of components due to independent rounding.

Sources: 1995 (except for prices): Energy Information Administration (EIA), Annual Energy Review 1996, DOE/EIA-0384(96) (Washington, D.C., July 1997). Prices and all projections: EIA, AEO98 National Energy Modeling System run AEO98B.D100197A.

APPENDIX C

Example Answer Sheet

An example GPRA 2000 Answer Sheet is provided in this appendix to serve as a guide. The example provides information for a fictitious energy supply planning unit called "Omega" and should not be construed as genuine.

SECTION A

5-Year Goal Statement

A well structured 5-year goal is a brief statement that describes the results an organization expects to achieve and how it intends to achieve them. This goal provides important context for annual progress commitments, particularly for persons not familiar with EERE programs. The goal should be measurable, quantitative where possible, and linked with annual progress goals. The 5-year goal statements should also be consistent with similar statements developed for EERE's FY2000 budget request.

With the DOE five year budget cycle, the end year for the 5-year goal will preferably be 2004. However, a program may use an existing, more logical end year such as 2003 or 2005. An example format for a 5-year goal statement would read as follows:

> By 2004, in collaboration with [major partner groups], the [planning unit name] will engage in [research, development, and/or deployment activities] in order to address [strategies] to achieve the [long-term results] which will meet the need(s) of [customers] when compared to [the base year or base level] for these results.

"Strategies" are an important component of the 5-year goal statement, as they identify the method for achieving the longer term goal and provide the basis for organizing annual milestones. See Appendix A and the Milestones and Assumptions section for additional explanation.

Please write your 5-year goal statement in the box below. Alternatively, the 5-year goal statement may be entered directly into the GPRA database located on the world-wide web at http://bowens2.nrel.gov/gpra (a secure site). The default value in the database is the 5-year goal statement provided for the FY 1999 data call.

By the year 2004, in collaboration with the electric utilities industry, the Omega planning unit will engage in R&D activities designed to increase the strength and decrease the weight of Omega technology and integrate the advances into a demonstration unit, thereby reducing the costs of electricity produced from Omega technology to 4 cents/kWh and fostering an increase in Omega capacity. The expected outcome of this research is a 15% reduction in the cost of electricity generated by Omega technology and a 25% increase in Omega capacity by the year 2004 relative to 1996. This additional capacity will improve the environment by eliminating 10 MMT of SO_2, and diversifying America's energy supply by increasing its renewable energy capacity to 13% of total installed electricity capacity in 2004.

SECTION B

FY1997 & FY1998 Accomplishments

GPRA requires that departments provide a basis of comparison for their performance goals and measures. That is, what is the current or past level of performance? Accordingly, the accomplishments tables that follow request current (FY1997 & FY1998) levels of performance for the goals and impact estimates you will provide in the remainder of the data call: resources received, milestones accomplished, as well as energy, financial and environmental impacts. Accomplishments should be consistent with information provided for EERE's FY2000 budget request.

Data may be entered into the tables that follow or directly into the GPRA database located on the world-wide web at http://bowens2.nrel.gov/gpra (a secure site).

FY1997 Accomplishments

RESOURCES

	$ Million
1997 Budget Request	75
1997 Budget Appropriation	67
1997 Partners Investment	100
1997 Partners Non-Financial Investment	25

MILESTONES

Source	FY1997 Milestones	Milestone Cost to EE ($ million)
GPRA 1999 Estimate	Reduce cost of electricity generated with Omega technology to 6 cents/kWh	275
GPRA 2000 Actual	Reduced cost of electricity generated with Omega technology to 6 cents/kWh	250
GPRA 1999 Estimate	Reach an agreement with 4 utilities to move forward with a demonstration project	15
GPRA 2000 Actual	Reached an agreement with 4 utilities to move forward with a demonstration project	15
GPRA 1999 Estimate		
GPRA 2000 Actual		

ENERGY, FINANCIAL AND ENVIRONMENTAL IMPACTS

Target Market	Unit of Measurement	Number of Units in the Market	Primary Energy Displaced (trillion Btu)	Energy Cost Savings ($ million)	Carbon Displaced (MMTCE)
Electricity generation	MW of capacity	750	25	.05	.56

FY1998 Accomplishments

RESOURCES

	$ Million
1998 Budget Request	80
1998 Budget Appropriation	60
1998 Partners Investment	100
1998 Partners Non-Financial Investment	25

MILESTONES

Source	FY1998 Milestones	Milestone Cost to EE ($ million)
GPRA 1999 Estimate	Complete phase one of Omega demonstration project	150
GPRA 2000 Actual	Completed phase one of Omega demonstration project	150
GPRA 1999 Estimate		
GPRA 2000 Actual		
GPRA 1999 Estimate		
GPRA 2000 Actual		

ENERGY, FINANCIAL AND ENVIRONMENTAL IMPACTS

Target Market	Unit of Measurement	Number of Units in the Market	Primary Energy Displaced (trillion Btu)	Energy Cost Savings ($ million)	Carbon Displaced (MMTCE)
Electricity generation	MW of capacity	760	26	.06	.57

SECTION C

Inputs: Resources Metric

Resources significantly impact the ability of planning units to achieve their goals. We are therefore requesting information about the level of resources used in estimating your planning unit's milestones and impacts. The table that follows requests information about the planning unit's funding estimates for FY1999 through FY2020, the percentage of funding allotted to research, development, and deployment, the level of partner investment in the planning unit (both financial and non-financial), and the number of partners with whom you are working. Estimates only need to be provided through FY2004 (i.e., fields for 2005-2020 may be left blank). Funding level estimates should be consistent with the "Program Outyear Funding Table" developed for EERE's FY2000 budget request (table attached).

Resource metrics may be entered into the table that follows or directly into the GPRA database located on the world-wide web at http://bowens2.nrel.gov/gpra (a secure site). The default values in the database are the values provided for the FY 1999 data call.

Omega Planning Unit (BTS) GPRA2000 Data Submission

Data Submitted by: Example

Resource Metrics

Metric	1999	2000	2001	2002	2003	2004
GPRA2000 DOE Funding Level (Millions of $'s)						
GPRA99 DOE Funding Level (Millions of $'s)	$11.749	$12.100	$12.500	$12.900	$13.400	
GPRA2000 Research (%)						
GPRA99 Research (%)	5%	5%	5%	5%	5%	
GPRA2000 Development (%)						
GPRA99 Development (%)	60%	60%	60%	60%	60%	
GPRA2000 Deployment (%)						
GPRA99 Deployment (%)	35%	35%	35%	35%	35%	
GPRA2000 Partner Financial Investment (Millions of $'s)						
GPRA99 Partner Financial Investment (Millions of $'s)	$5.000	$8.000	$55.000	$55.000	$55.000	
GPRA2000 Partner Non-Financial Investment (Millions						
GPRA99 Partner Non-Financial Investment (Millions of $'s)	$5.000	$10.000	$15.000	$30.000	$45.000	
GPRA2000 Partners (Number)						
GPRA99 Partners (Number)	145	300	500	960	1,200	

SECTION D

Outputs: Milestones and Assumptions

This section of the data call collects information about milestones and assumptions for the planning unit's technologies and/or deployment activities. Milestones and assumptions describe the outputs leading to, and the underlying factors behind, planning unit impact estimates and long-term goals. Milestones also document the steps that must be completed for some of the assumptions to be realized. For example, a program manager may estimate that a technology will save 50 TBtu of energy in 2005. A key assumption behind this estimate is that the technology will penetrate 20% of the target market by the year 2005. To help reach this target, the planning unit has milestones intended to bring about the 20% market penetration target. These and other milestones and assumptions should be provided.

Milestones are grouped along to two dimensions. First, milestones are classified by the strategy in the 5 year goal statement to which they pertain. A strategy is a method for achieving longer term goals and a planning unit may have one or more of them. For instance, a goal may be to achieve an 80 mpg vehicle by 2004. A strategy for achieving this goal is to reduce the weight of the vehicle. Milestones related to this strategy would be placed on one sheet and milestones related to another strategy (e.g., improving aerodynamics) on a separate sheet. Second, milestones are grouped according to whether they are intended to improve a technology's characteristics or its penetration into the market (milestones may also be tagged as "other" when they do not easily fall into one of the other two categories). Accompanying each milestone should be an estimate of the cost to EERE for achieving that milestone. This estimate is only cumulative when the cost has occurred over a number of years and has not been included in an earlier milestone. To the extent possible, costs should only be counted under one milestone even though the work may overlap with other milestones. **Although it appears numerous milestones are being requested, only one or two milestones per year need to be submitted. Strategies, technology characteristics, and market penetration are simply means of classifying the milestones. Milestones should be significant enough to include in the Secretary's Performance Agreement with the President and should be consistent with milestones provided in EERE's FY2000 budget request.**

Milestones may entered into the tables that follow (copies may be made if there is more than one strategy) or directly into the GPRA database located on the world-wide web at http://bowens2.nrel.gov/gpra (a secure site). Milestones from last year's data call are contained on the web but should be updated for this year's effort.

A format for assumptions is not being provided this year. Each sector is free to develop its own format, as long as the format allows assumptions to be easily related to both milestones and impacts. At a minimum, assumptions should identify the target market size, market penetration levels, technology performance levels, and technology cost. **Assumptions should be submitted along with the remainder of the data call**.

GPRA 2000 Milestones

Strategy: Increase strength of Omega technology		
Fiscal Year	**Technology Characteristics Milestones**	**Estimated Milestone Cost to EE ($ million)**
1999		
2000		
2001	Complete field testing of phase three Omega technology that improves strength by 25% over phase two technology.	3.0
2002		
2003		
2004		
XXXX	**Market Penetration Milestones**	XXXXXXXX
1999	Complete phase two of the Omega 25 MW demonstration project containing technology with strength 10% above existing units	5.0
2000		
2001		
2002		
2003	Complete construction of phase three 110 MW demonstration facility that uses Omega's composite material to improve technology strength by 25% and reduce installation costs by $75/kW over phase one technology.	6.0
2004		
XXXX	**Other Milestones**	XXXXXXXX
(year)		

GPRA 2000 Milestones

Strategy: Improve efficiency of Omega technology.		
Fiscal Year	**Technology Characteristics Milestones**	**Estimated Milestone Cost to EE ($ million)**
1999		
2000	Complete field testing of phase three Omega technology that improves efficiency by 20% over phase two technology.	2.0
2001		
2002		
2003		
2004		
XXXX	**Market Penetration Milestones**	XXXXXXXX
1999		
2000		
2001		
2002	Complete construction of 215 MW demonstration facility that uses Omega's technology to improve efficiency by 20% and reduce installation costs by $50/kW over phase two technology.	9.0
2003		
2004		
XXXX	**Other Milestones**	XXXXXXXX
(year)		

GPRA 2000 Milestones

Strategy: Integrate Omega technology advances into a demonstration unit.		
Fiscal Year	**Technology Characteristics Milestones**	**Estimated Milestone Cost to EE ($ million)**
1999		
2000		
2001		
2002		
2003		
2004	Complete systems integration field testing using technologies that increase strength by 25% and efficiency by 20%.	2.0
XXXX	**Market Penetration Milestones**	XXXXXXXX
1999		
2000		
2001		
2002		
2003		
2004		
XXXX	**Other Milestones**	XXXXXXXX
(year)		

SECTION E

Impacts: Energy, Financial, and Environmental Metrics

This section requests information on planning unit impacts in three areas: energy, financial, and environmental. The majority of information being requested is similar to last year's data call.

When providing information in this section, it is important that you clearly understand what data are being requested. To assist in this effort, a definition of all key terms appears in Appendix A. We encourage you to review these definitions if there is uncertainty regarding the meaning of a term.

In addition, please refer to Appendix B (*Calculations Methodology and Assumptions*) if you have questions about the assumptions that are common to the costs and benefits calculations of all the sectors, as well as if you have questions about how to calculate certain metrics.

Energy, Financial and Environmental metrics may be entered into the tables that follow or directly into the GPRA database located on the world-wide web at http://bowens2.nrel.gov/gpra (a secure site). The default values in the database are the values provided for the FY 1999 data call.

Omega Planning Unit (BTS) GPRA2000 Data Submission

Data Submitted by: Example

Energy Metrics

Metric	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
GPRA2000 Total Primary Energy Displaced (Trillion Btu)										
GPRA99 Total Primary Energy Displaced (Trillion Btu)	3.69	6.78	10.47	15.08	22.43		41.93	150.98	331.79	541.21
GPRA2000 Direct Electricity Displaced (Billion Kilowatthours)										
GPRA99 Direct Electricity Displaced (Billion Kilowatthours)	0.35	0.58	0.86	1.22	1.74		3.15	11.06	24.56	40.63
GPRA2000 Direct Natural Gas Displaced (Billion Cubic Feet)										
GPRA99 Direct Natural Gas Displaced (Billion Cubic Feet)	0.07	0.73	1.34	2.24	3.79		8.19	31.42	66.08	101.68
GPRA2000 Direct Petroleum Displaced (Million Barrels)										
GPRA99 Direct Petroleum Displaced (Million Barrels)	0	0.01	0.02	0.05	0.08		0.19	0.80	1.86	3.08
GPRA2000 Direct Coal Displaced (Million Short Tons)										
GPRA99 Direct Coal Displaced (Million Short Tons)	0	0	0	0	0		0	0	0	0

Financial Metrics

Metric	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
GPRA2000 Energy Costs or Savings (Billions of $'s)										
GPRA99 Energy Costs or Savings (Billions of $'s)	$0.028	$0.050	$0.075	$0.108	$0.158		$0.287	$1.000	$2.141	$3.403
GPRA2000 Non-Energy Savings or Costs (Billions of										
GPRA99 Non-Energy Savings or Costs (Billions of $'s)										

Omega Planning Unit (BTS) GPRA2000 Data Submission

Data Submitted by: Example

Environmental Metrics

Metric	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
GPRA2000 CO Displaced (MMTons)										
GPRA99 CO Displaced (MMTons)										
GPRA2000 Carbon Equivalent Emissions Displaced (MMTons)										
GPRA99 Carbon Equivalent Emissions Displaced (MMTons)	0.09	0.15	0.23	0.34	0.49		0.92	3.27	7.22	11.83
GPRA2000 Other Greenhouse Emissions Displaced (MMTons)										
GPRA99 Other Greenhouse Emissions Displaced (MMTons)										
GPRA2000 SO2 Displaced (MMTons)										
GPRA99 SO2 Displaced (MMTons)	0	0	0.01	0.01	0.01		0.03	0.09	0.21	0.34
GPRA2000 NOx Displaced (MMTons)										
GPRA99 NOx Displaced (MMTons)	0	0	0	0.01	0.01		0.01	0.05	0.11	0.19
GPRA2000 Particulates Displaced (MMTons)										
GPRA99 Particulates Displaced (MMTons)										
GPRA2000 VOCs Displaced (MMTons)										
GPRA99 VOCs Displaced (MMTons)										
GPRA2000 HCs Displaced (MMTons)										
GPRA99 HCs Displaced (MMTons)										
GPRA2000 Other Environmental Benefits										
GPRA99 Other Environmental Benefits (Thousand Tons)										

Appendix B

Arthur D. Little Report on Review of Planning Unit Estimates

Summary of Findings – Peer Review of the FY2000 GPRA Assumptions

Report to
National Renewable Energy Laboratory

March 1999

In response to TOA Number
KDC-9-18631-00

Arthur D. Little, Inc.
Acorn Park
Cambridge, Massachusetts
02140-2390

Reference 39666

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Introduction

The Government Performance and Results Act (GPRA) requires federal agencies to establish performance goals for their programs. Programs within the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE) develop goals through a process referred to as the GPRA data call, formerly known as the Performance Measurement and Quality Metrics data call. EERE systematically develops and confirms in an annual GPRA process and data call, credible, quantitative goals, both near term and longer-term, for the performance and impact of its programs. The goal of the EERE GPRA process is to measure, manage, and improve program performance and meet GPRA requirements for strategic planning and annual performance plans and reports.

Approach

Arthur D. Little worked with DOE staff to review the estimates and assumptions for selected Planning Units within four sectors of EERE. The review process is an interactive, iterative process between the individual Planning Unit managers and Arthur D. Little experts, in each case leading to a consensus regarding the final submissions. Arthur D. Little evaluated two primary metrics for the FY2000 data call:

- The energy and emission savings of each technology projected for the years 2000 through 2020, which depend on estimates of market penetration, cost, and performance assumptions for each technology.
- The performance measurements of each Planning Unit, which include near-term goals and milestones for the next five years designed to achieve the market penetration, cost, and performance objectives underlying the energy savings metrics.

With few exceptions, the discussions between Arthur D. Little and the Planning Units within EERE have resulted in agreement on revised program impact estimates and addition of related performance measures.

The 9 Planning Units reviewed for GPRA FY2000 include:

Office of Transportation Technology (OTT)
- Advanced Automotive Technologies

Office of Power Technologies (OPT)
- Photovoltaics
- High Temperature Superconductivity
- Hydropower

Office of Industrial Technologies (OIT)

- Glass Vision
- CFCC
- Metals Casting

Office of Building Technology and State/Community Programs (BTS)

- Residential Buildings Integration
- Commercial Buildings Integration

The majority of the Planning Units were selected based on the following criteria:

- large expected energy savings
- large program visibility
- significant variables impacting the Planning Units from last years analysis (e.g., the Presidents Million Roof Initiative in the Photovoltaic Planning Unit)
- desire to review all Planning Units every four years

The following tables summarize the results of the GPRA FY2000 analysis. In general, Arthur D. Little has seen improvement in the credibility of the GPRA information since working with DOE on this effort since 1994. Arthur D. Little has worked with the DOE staff to develop credible estimates/assumptions impacting energy saving and emission reduction estimates. Our overall findings are provided in Tables 1 through 4.

Table 5 shows the final energy savings estimates for all of the planning units for EERE. There may be some slight differences between Tables 1 through 4 and Table 5 due to revisions to estimates based on increased funding levels that occurred after the review. The final FY2000 program impact estimates may differ in some cases 2000 budget request since the revised numbers were estimated. In cases where a program did receive a FY2000 budget request increase, the revised submission served as the baseline for estimating the final program impact estimate.

Table 1: OTT Planning Unit Summaries

Advanced Automotive Technologies Planning Unit					
Advanced Automotive Technologies (EV, F/C, HEV, Adv. Heat Engines)					
	Total Primary Energy Displaced (Trillion BTU)				
	2000	**2005**	**2010**	**2015**	**2020**
Preliminary Draft*	0	2	401	N/A	1,128
Final Submission	0	32	639	1215	1,589
Electric Vehicles R&D					
Final Submission	0	2	12	17	19
Fuel Cell Powertrains R&D					
Final Submission	0	0	27	128	246
Hybrid Vehicle R&D					
Final Submission	0	21	270	547	712
Advanced Light Duty Heat Engine R&D (Advanced Diesel and SIDI)					
Final Submission	0	8	330	523	612
Advanced Diesel	*(0)*	*(0)*	*(220)*	*(328)*	*(383)*
SIDI	*(0)*	*(8)*	*(110)*	*(195)*	*(229)*

MAJOR FINDINGS FOR QM

- Overall market size, energy consumption, and emissions are consistent with trade group and government agency compilations and predictions.
- The predicted new sales of advanced automotive technology vehicles are consistent with industry capacity and change-over capability.
- The fuel economy goals for mature fuel cell powertrains as compared to mature hybrid electric vehicles (3.0x vs 2.0x) was recognized by the DOE analytical team as inconsistent. Revised targets assigning a 10% fuel economy premium to fuel cells as compared to hybrid electric vehicles (2.2x vs 2.0x) were used for the Final QM submission.
- For other advanced automotive technologies and vehicle classes, the fuel economy goals are reasonable.
- Vehicle cost estimates are aggressive, but within reasonable limits.
- The fuel economy goals for mature hybrid vehicles (using heat engines or fuel cells) are shy of the ultimate PNGV goal (2.2x vs 3.0x). Thus, the QM analysis seems somewhat conservative rather than overly optimistic.

MAJOR FINDINGS FOR PM

- The performance measures and key milestones are consistent with the overall QM forecasts, and the advanced automotive technology programs appear to be making good progress in all key areas.
- It would be useful to explicitly identify more detailed technological milestones.
- Several additional advanced technologies could play important roles for future transportation, and should be considered by the OTT.

DOE RESPONSES AND ACTIONS

- Agreement was reached with the DOE-OTT analytical team on reducing the fuel economy for the mature fuel cell powertrain vehicles to be more consistent with heat engine-powered hybrid vehicles. There are no additional major adjustments.

* Values included in *Program Analysis Methodology Office of Transportation Technologies Quality Metrics 2000* - preliminary draft November 1, 1998 (based on 10/1/98 results), prepared by OTT Analytical Team.

Table 2: OPT Planning Unit Summaries

Planning Unit					
Photovoltaics					
	Total Primary Energy Displaced (Trillion Btus)				
	2000	**2005**	**2010**	**2015**	**2020**
Preliminary Draft	.18	1.07	3.89	7.76	11.74
Final Submission	.25	1.20	6.00	18	49

MAJOR FINDINGS FOR QM

- It was very difficult to track the assumptions that were used to generate the photovoltaic GPRA numbers. Next year the program should make the analysis more transparent and clear
- Spreadsheet data for system prices that were originally assumed were used in the GPRA analysis did not match estimates of system prices provided in the DOE/EPRI Technology Characterizations
- The average PV system prices are reasonable for 2000. The 2005 and beyond system prices are aggressive, but achievable assuming volume installations of larger scale systems, major thin film and BOS advances, and module efficiency improvements
- The O&M prices seem reasonable as do the capacity factor numbers
- Next year, DOE might assume that tracking systems are used for some grid-sited distributed applications (substations etc.). A single axis, flat plate PV system in Phoenix, for example, will have a capacity factor of 33% vs. the 20.5% used in the analysis this year
- The market penetration estimates appear conservative, especially for the years 2010 and beyond. The growth rate between 2015 and 2020, for example, is around 9%, which is very conservative. Beyond 2010 much more aggressive market penetration estimates are recommended
- Some of the Million Solar Roof budget has been reinstated. Market penetration estimates in the early years should be slightly more aggressive due to the catalyst of the Million Solar Roof program. By 2005, PV costs for site based systems will achieve levels that begin to justify the installations, especially given the additional benefits of improved power reliability and enhanced flexibility. Increasingly favorable economics combined with financing flexibility such as rolling the cost into a home mortgage, will result in an accelerated rate of installation past 2005.

MAJOR FINDINGS FOR PM

- The performance measurement targets do not adequately address the milestones needed to achieve the PV market penetration targets.
- Milestones should be set in terms of MW/yr goals of installations for each of the next five years.
- Goals should be set to successfully manage the PVMat program's cost reduction goals. PVMat technical results (yields, efficiency, stability etc.) should be tied to manufacturing cost reduction objectives.
- The year 2002 has no milestone targets.

DOE RESPONSES AND ACTIONS

- DOE agreed to modify the market penetration estimates to better reflect the partial reinstatement of the Million Solar Roof budget and the low system prices after the year 2005
- DOE provided additional inputs for the PM targets
- DOE agreed to make the assumptions more transparent for the 2001 review

Table 2: OPT Planning Unit Summaries (continued)

Planning Unit					
High Temperature Superconductivity (HTS)					
	Total Primary Energy Displaced (Trillion Btus)				
	2000	**2005**	**2010**	**2015**	**2020**
Preliminary Draft	0.0	0.01	0.16	1.75	8.04
Final Submission	0.0	0.0	0.13	1.79	8.51
	MAJOR FINDINGS FOR QM • The timeline between prototype demonstration and market penetration appears to be aggressive. The first year of market introduction was pushed backed 2 to 4 years. • The market adoption rates for HTS technologies appear to be conservative and were accelerated. • These two effects tend to offset each other and the overall numbers are similar to the DOE preliminary draft. **MAJOR FINDINGS FOR PM** • The link between PM and the program goals need to be strengthened. The goals include both increases in current carrying capacity as well as cost reductions for HTS technology. The PM concentrates on technology accomplishments with a scant mention of cost reduction milestones. • The adoption of HTS technologies is segmented along four markets: motors, generators, transformers, and cables. The milestones mention only achievements with motors and cables with no mention of generators. There needs to be milestone accomplishments for generators and transformers before these technologies are ready for commercial introduction and adoption. • Partnering with the private sector is projected to be more important in the out years, both in terms of funding levels and number of partners. PM should therefore reflect the increasing importance of private partnerships. **DOE RESPONSES AND ACTIONS** • DOE and ADL agreed to delay the first year of market penetration for HTS technologies. • DOE and ADL agreed to more aggressive market adoption scenarios.				
Planning Unit					
Hydropower					
	Total Primary Energy Displaced (Trillion Btus)				
	2000	**2005**	**2010**	**2015**	**2020**
Preliminary Draft	36	119	229	293	303
Final Submission	8	25	80	148	183
	MAJOR FINDINGS FOR QM • The adoption of the advanced turbine is segmented along three different markets: existing Federal facilities, existing private facilities that are up for FERC license renewal, and the potential for new capacity development. The potential market size for each segment is assessed individually.				

Table 2: OPT Planning Unit Summaries (continued)

Planning Unit	
Hydropower (continued)	
	MAJOR FINDINGS FOR QM (continued) • The numbers proposed by DOE represent the technical market potential for the advanced turbine program where the turbine can meet the technical requirement of the sites. An analysis needs to be conducted to assess the economic viability and the potential rate of adoption of the advanced turbine. • The adoption rates of the new turbine are aggressive for all market segments and should be scaled back. • New hydropower development potential is diminishing relative to past trends. The DOE preliminary numbers for new capacity additions are scaled back to reflect fewer new capacity developments and slower market adoption of the advanced turbine. **MAJOR FINDINGS FOR PM** • PM data is extremely limited and concentrates on the timeline of model testing and development. There is no mention of technical achievements of the model such as the amount of fish mortality and dissolved oxygen in the water. The program should add technical milestones for program activities that will help to reduce fish mortality or improve dissolved oxygen concentrations. • The program goal includes collaborations and increasing financial participation from private industries. The PM data should reflect the increasing importance of private partnership especially in the out years. **DOE RESPONSES AND ACTIONS** • DOE and ADL agreed to modify the projections for new capacity additions. • DOE and ADL agreed to modify the rate of technology adoption. DOE adjusted the preliminary draft numbers for the GPRA review. These estimates may now not agree with hydropower numbers submitted for other purposes.

Table 3: OIT Planning Unit Summaries

Planning Unit					
Glass Vision					
	Total Primary Energy Displaced (Trillion Btus)				
	2000	**2005**	**2010**	**2015**	**2020**
Preliminary Draft	-	22 (*2.8*)	40 (*6.2*)	53 (*12.3*)	65 (*20.2*)
Final Submission	-	23 (*2.8*)	40 (*6.2*)	56 (*12.3*)	73 (*20.2*)

Figures in parentheses are included in the totals but are attributable to end-use benefits of the glass products

GENERAL FINDINGS

- Eight of the most significant projects in the Glass Vision planning unit were reviewed.
- Savings projected from these eight projects range from about 10% of the energy use in the glass industry by the year 2005 to about 20% of projected energy use in the year 2020.
- Analysis and assumptions for the QM projections submitted in the initial submission were not well documented, but turned out to be reasonable based on subsequent discussions with the DOE program managers.
- Though significant errors were made in the calculation of the benefits (apparently in transcription of the assumptions to the spreadsheet), the errors almost completely canceled each other out, so that the final submission almost equals the original submission.
- Potential overlap between various projects will probably mean that not all the savings projected will be achieved if all projects are successful (i.e. if the savings from the first technology are 10%, the second technology has only 90% left to save from). This is particularly true for the glass melter and combustion technology-related programs. However, savings from projects not reviewed will likely off-set this double-counting to some extent. We believe that the approach chosen is a reasonable one, given the practical limitations for the GPRA analysis.
- PM milestones and goals were not clearly defined for each of the projects. We strongly recommend that they be included next year, as it is impossible to judge whether adequate progress will be made to justify the timelines assumed in the benefits' projections. We recommend that these PM milestones and goals, as well as go-no-go decision points and funding information be included in the templates during proposal evaluation to facilitate consistent portfolio evaluation and management.

MAJOR FINDINGS FOR QM

Diagnosis and Modeling of High Temperature Corrosion of Superstructure Refractories in Oxy/Fuel Glass Furnaces

- Energy savings appear realistic. However, a transcription error seems to have led to estimated energy usage numbers that are approximately a factor of 1000 too low. The proposal claims the fuel usage of 30 plants to be 6E11 Btu/year, i.e. 20 billion Btu/year per plant. However, energy use of the current technology is claimed as 16 million Btu/yr. We recommend that the numbers be changed accordingly. DOE agreed and the table above reflects these changes.
- Market size, share, and penetration assumptions appear reasonable given that this is not a technology as much as a method for applying technology

Table 3: OIT Planning Unit Summaries (continued)

Planning Unit	
Glass Vision (continued)	
	Development of Advanced Precursor Systems for On-Line Coating of Float Glass • The above table reflects energy benefits that apply to the end-use of the glass product, not to the manufacturing process. • A decimal point transcription error appears to have led to a serious underestimation of the market size (i.e. the annual output from a typical float glass plant is more than 108 ft2, even if not all float glass plants will sell coated glass). The error was recognized by DOE and corrected as shown in the table above. • Market introduction in 2000 (as proposed in the initial submission) appears unlikely, unless field demonstrations are already prepared. DOE agreed to change the market introduction to 2005. Changes are reflected in the table. • Market penetration class was not filled in, but should probably be b or c. DOE agreed and the changes are reflected in the table. **High Heat Transfer, Low Nox Natural Gas Combustion System** • The energy savings assumptions are reasonable • Market share appears unreasonably high, given the number of competitors. We recommend 50% as a more realistic figure. This change is reflected in the table above. **Integrated Ion Exchange Systems for High Strength Glass Products** • The above table reflects energy benefits that apply to the end-use of the glass product, not to the manufacturing process. • Market size and growth assumptions appear reasonable **Dynamic Expert Systems Control for Optimal Oxy-Fuel Melter Performance** • Energy use assumptions appear rather low. It was claimed that energy savings for this technology were calculated based on a \$50-\$60 million/yr cost savings. Assuming an average energy cost of \$4 per thousand BTU, this would translate into savings of roughly 15 billion BTU/yr per unit. However, energy savings of 15 million BTU/yr per unit are reported. We recommend that the energy numbers be raised by 1000. This is reflected in the table above. • Market size and growth assumptions appear reasonable • 2000 market introduction appears unlikely given the R&D completion date of 2001. Given the nature of the technology (mostly software-based), we recommend 2002 as a more realistic date. DOE agreed to the change, which is reflected in the table above. **Synthesis and Design of Silicide Intermetallic Materials** • The P.I. was not able to provide energy usage numbers and did not substantiate assumptions. Because of the lack of data, the energy impacts of this technology have not been included in the table above. **Auto-glass process control** • The P.I. claimed a 10% reduction in energy usage for the proposed technology, but did not provide total energy usage numbers. Due to the lack of data, the benefits of this technology cannot be accurately assessed and were omitted from the table above.

Table 3: OIT Planning Unit Summaries (continued)

Planning Unit	
Glass Vision (continued)	
	Cullet Batch Preheater • The technology description mentions 15% energy savings, (which is reasonable), but the table shows a 40% savings. We recommend that the savings be adjusted to 15%. DOE recognized the inconsistency and the projections were changed accordingly, as reflected in the table. • A 1997 market introduction is incorrect. We recommend that this be adjusted to 1999. These changes are reflected in the table above. **MAJOR FINDINGS FOR PM** **Diagnosis and Modeling of High Temperature Corrosion of Superstructure Refractories in Oxy/Fuel Glass Furnaces** • Technical milestones and deliverables are reasonable and well documented. **Development of Advanced Precursor Systems for On-Line Coating of Float Glass** • No milestones were provided by the project P.I. Given this, the 2000 market introduction appears highly unlikely. As mentioned, the market introduction was modified. This inconsistency emphasizes the importance of having both QM and PM information for the programs reviewed. **Integrated Ion Exchange Systems for High Strength Glass Products** • Technical milestones and deliverables are reasonable and consistent with the anticipated commercialization date. **Dynamic Expert Systems Control for Optimal Oxy-Fuel Melter Performance** • Technical milestones and deliverables are reasonable. • As the development phase is expected to be complete by late 2001, a 2000 market introduction date is unlikely. We recommend 2002 as a more likely date. This change was accepted as discussed above. **PM data for other projects was not available for review. We strongly recommend that PM data be added in future.** **DOE RESPONSES AND ACTIONS** • Discussions were held with the Glass Vision Planning Unit and agreement was reached on making the recommended changes to the energy usage numbers and market introduction date. Two projects claimed that energy benefits would be derived from the end-use of the glass products rather than from their manufacture (Development of Advanced Precursor Systems for On-Line Coating of Float Glass and Integrated Ion Exchange Systems for High Strength Glass Products). Since these are OIT projects, the use of non-industrial QM's was questioned. However, it was decided not to adjust the numbers.

Table 3: OIT Planning Unit Summaries (continued)

Planning Unit					
CFCC					
	Total Primary Energy Displaced (Trillion Btus)				
	2000	**2005**	**2010**	**2015**	**2020**
Preliminary Draft	-	64	194	312	460
Final Submission	-	25	60	100	149

GENERAL FINDINGS

- Provides a good example of a cross-cutting program that effectively supports a core technology that can be applied across a broad range of industrial processes. The core technology is likely to have numerous further industrial applications.
- Analyses for GPRA submission and numbers were generally well documented, reasonable, and displayed a good understanding of the projects and their benefits by project managers and principal investigators. Nevertheless, a number of minor inaccuracies amounted to an overestimation of the benefits as is shown in the table above.
- DOE staff did their best to cooperate under the tight time schedule and were generally quite knowledgeable of their projects.
- The diversity of CFCC applications suggests that little or no overlap will exist between energy savings of different elements of the programs. In fact, other spin-off applications that are not yet considered are likely to occur.
- Performance measures generally show a logical succession of overall program activities with reasonably defined milestones and goals. However, for future submissions and for portfolio management we recommend a slightly more detailed description of the performance metrics. We recognize that such metrics do exist within the individual programs, but an organized central overview of them would probably be very beneficial. Preferably they would be included on the template for collection.

MAJOR FINDINGS FOR QM

Ceramic Turbine Components

- Assumptions on energy savings, market size, and technology classification are generally reasonable and well documented
- Savings are not strictly accrued in industry as large turbines like these are primarily used in power generation in utilities currently
- The projected market growth rate of 14% is unrealistically high, as it is doubtful whether this can be sustained over a 20-year period. A more conservative rate of 5 or 6% is recommended. DOE has agreed to these changes. This is reflected in the table above.

Infrared Burners

- Total market, market share, market penetration, and cost and equipment life assumptions are reasonable and in line with information
- Assumptions of energy savings per burner are assumed at 40%, which is the high end of the range (25-40%) indicated. While 40% is probably achievable in some applications, in others there will not be any energy savings (especially in comparison with electric IR systems). Therefore a lower energy savings number should be used across the board (30% seems reasonable). DOE has agreed to lower these savings to 30%. This change is reflected in the table above.
- The targeted markets are textiles, paper, paints, and coatings, none of which industries have a four- percent growth rate. Two percent would seem more reasonable. DOE agreed to the more conservative assessment that is reflected in the table above.

Table 3: OIT Planning Unit Summaries (continued)

Planning Unit	
CFCC (continued)	
	Ceramic Furnace Fan • Assumptions on energy use, cost, life, and market estimates seem reasonable. **Hot Gas Filters** • Assumptions for energy savings are reasonable • Is the market meant to just represent industrial sites or power generation in general? Assumptions for market size are reasonable, although it would be better to use a plant as a unit, rather than a filter (you can't install 1/5000 of a plant!). As these suggestions would not affect the ultimate outcome, no changes to the analysis were recommended. • Market share may be optimistic, as the technology will probably also compete with high temperature sintered alloy filters. Given the significant debate over the relative merits of various filter types for these applications, it was decided not to make changes to the analysis. • As the technology requires the switch to APFBC technology, which requires very major investments in plant with a life of 25 –40 years, the classification of the technology as b (full market penetration within 10 years) seems too aggressive, especially when considering the history of alternative coal-based power generation technologies. Class c (full market penetration within 25 years) would appear more appropriate. DOE agreed to these changes and they are reflected in the table above. **Immersion Tube Burners** • The assumptions for energy consumption appear reasonable, but there appears to be an error in the calculation involving natural gas usage for the conventional and proposed technologies: 2 billion lbs/yr /2000 lbs/ton *9 million BTU/ton (natural gas) /1000 BTU / 3100 units = 0.0029 BCF/yr, compared with 1.16 BCF/yr reported in the input spreadsheet. We recommend that this error be corrected and DOE agreed. This is reflected in the table above. • Energy savings of 36% are quoted, but it is not clear what that is compared with. It appears unlikely that identical savings can be achieved compared with competing gas and electric technology (i.e. what is the baseline). DOE explained satisfactorily that the savings are a weighted composite of the savings achievable compared with gas and electric technology. • Assumptions on market size and share appear reasonable. **Radiant Burners** • Assumptions on energy use, cost, life, and market estimates seem reasonable • Assumptions on the magnitude of energy savings appear reasonable (assuming higher emitter temperature is the cause for these savings), although it is not stated explicitly what causes the higher efficiency. DOE confirmed that the higher emitter temperature is the reason for the increased efficiency. **MAJOR FINDINGS FOR PM** **Ceramic Turbine Components, IR Burners, Hot Gas Filters, Immersion Tube Burners, and Radiant Burners** • Goals and milestones are reasonable and lead to the targeted commercialization date. A bit more detailed description would be valuable. I.e. aspects to be proven in field test.

Table 3: OIT Planning Unit Summaries (continued)

Planning Unit	
CFCC (continued)	
	Ceramic Furnace Fans • Performance Measures are not reported. Nevertheless, in the template, there is mention of a two-year demonstration program **DOE RESPONSES AND ACTIONS** • Discussions were held with the CFCC Planning Unit and agreement was reached on the proposed changes. Specifically, the market growth rate for the Ceramic Turbine Components project was lowered from 14% to 6%; the energy usage numbers for Immersion Tubes were corrected; and the energy efficiency increase for IR Burners was changed to 30%.

Planning Unit					
Metals Casting					
	Total Primary Energy Displaced (Trillion Btus)				
	2000	**2005**	**2010**	**2015**	**2020**
Preliminary Draft	-	11	26	55	89
Final Submission	-	8	20	46	77

GENERAL FINDINGS

- Analyses for GPRA submission and numbers were generally well documented, reasonable, and displayed a good understanding of the projects and their benefits by project managers and principal investigators. Nevertheless, a number of minor inaccuracies amounted to a slight overestimation of the benefits as is reflected in the table above.
- DOE staff did their best to cooperate under the tight time schedule and were generally quite knowledgeable of their projects.
- The savings projected above represent a reduction of almost 20% in the year 2020. In earlier years the savings are substantially lower.
- Given the large number of projects in the metals casting vision there is some potential for overlap between various projects that may cause some double-counting if all projects are successful (i.e. if the savings from the first technology are 10%, the second technology has only 90% left to save from). However, savings from projects not reviewed will likely offset this double counting to some extent. We believe that the approach chosen is a reasonable one, given the practical limitations for the GPRA analysis.
- Performance Measures generally show logical succession of overall program activities with reasonably defined milestones and goals. However, for future submissions and for portfolio management we recommend a slightly more detailed description of the performance metrics. We recognize that such metrics do exist within the individual programs, but an organized central overview of them would probably be very beneficial. Preferably they would be included on the template for collection.

Table 3: OIT Planning Unit Summaries (continued)

Planning Unit	
Metals Casting (continued)	
	MAJOR FINDINGS FOR QM **Gating of Aluminum Permanent Mold Castings,** **In-Stream Inoculation for Aluminum Alloy Casting Processes** **Reengineering of Steel Casting Manufacturing** **Predicting Pattern Tooling and Casting Dimensions for Investment Casting** **Clean Steel: Mach. of Clean Cast Steel; and Accelerated Transfer of Clean Steel Technology** **Steel Foundry Refractory Lining Optimization: EAFs** **Mold Materials for Permanent Molding** **Thin Wall Cast Iron** • Assumptions on energy savings, market size, competing technologies, and technology classification are reasonable **Die Materials for Critical Applications** • Assumptions on market size, and technology classification are generally reasonable and well documented • Energy savings are based on the assumption that foundries using this technology totally switch from using virgin aluminum to secondary aluminum. This may be too optimistic. No changes were made. **Enhancements in Magnesium Die Casting** • Assumptions on energy use and technology class are reasonable. • The target market needs to be better defined. It is claimed that this technology will result in an increased use of magnesium (over ferrous materials) in automotive parts, and that energy savings would result from the lower energy requirements of magnesium smelting. An appropriate target market might be to quantity of ferrous auto parts that could potentially be displaced by magnesium. However, the current target market was defined as the quantity of magnesium currently produced for the automotive sector. Probably, this analysis is more conservative than necessary. No changes were made. • Energy usage numbers appear to be high due to a few errors in the calculation (assumptions are reasonable). The unit is defined as one automobile with 250lb of replaceable castings. If ferrous castings require 41 million BTU/ton cast, then the energy usage for current technology is 41E+06 BTU/ton x 250 lb/2000 lb per ton = **5.125 million BTU/unit**. The specified energy usage for the current technology is 6000 kWh x 10,500 BTU/kWh + 20,000 cf x 1,030 BTU/cf = **83.6 million BTU/unit**. We recommend that the energy usage numbers for the current and proposed technologies be scaled down by a factor of 16.3 (from 83.6/ 5.125). These changes were agreed to by DOE and are reflected in the table above.

Table 3: OIT Planning Unit Summaries (continued)

Planning Unit	
Metals Casting (continued)	
	Optimization of the Squeeze Casting Process • Assumptions on energy use and technology classification are realistic and well documented • The target market needs to be better defined. It is claimed that this technology will result in an increased use of aluminum (over ferrous materials) for load-bearing automotive parts, and that energy savings would result from the lower energy requirements of aluminum smelting. An appropriate target market might be the quantity of ferrous load-bearing auto parts that could potentially be displaced by aluminum. However, the current target market was defined as the quantity of aluminum currently produced for the automotive sector. It is likely that the impact (if any) on the projections would be modest. No changes were made. • Energy usage numbers appear to be high due to some computational errors (assumptions were reasonable). The unit is defined as one automobile with 300lb of replaceable castings. If ferrous castings require 41 million BTU/ton cast, then the energy usage for current technology is 41E+06 BTU/ton x 300 lb/2000 lb per ton = **6.15 million BTU/unit**. The specified energy usage for the current technology is 6000 kWh x 10,500 BTU/kWh + 20,000 cf x 1,030 BTU/cf = **83.6 million BTU/unit**. We recommend that the energy usage numbers for the current and proposed technologies be scaled down by a factor of 13.6 (from 83.6/ 6.15). These changes were agreed to by DOE and are reflected in the table above. **Fast Response Measurements of Internal Die Cavity Temperatures** • Energy usage and market assumptions appear realistic • The market introduction date of 2000 is a little optimistic. We recommend a more conservative date such as 2002. These changes were agreed to by DOE and are reflected in the table above. **Casting Characteristics of Al Die Casting Alloys** • Energy savings assumptions are realistic • Since the project report is to be written in late 2000, a market introduction in that same year seems unlikely. A more reasonable date is 2002. These changes were agreed to by DOE and are reflected in the table above. **Qualitative Reasoning for Diecasting Design Applications** • Energy usage assumptions appear reasonable • The key deliverable, i.e. the final version of the software, is expected to be ready by late 2000, in view of this a market introduction date of 2000 is optimistic. 2002 would be more realistic. These changes were agreed to by DOE and are reflected in the table above. **Non Incineration Treatment to Reduce Benzene** • The energy usage and energy savings assumptions appear reasonable • Considering the technical milestones, the market introduction year of 2000 seems optimistic. We recommend 2002 as a more likely date. These changes were agreed to by DOE and are reflected in the table above. **Yield Improvement in Steel Casting (Yield II)** • Assumptions on energy savings, market size, and technology classification are generally reasonable and well documented • It seems unlikely that this technology will be introduced to the market by 2000. We recommend 2002 as a commercialization date. These changes were agreed to by DOE and are reflected in the table above. **Systematic Microstructural & Corrosion Performance Evaluation** Although the technological benefits are not clearly specified, the underlying energy assumptions seem reasonable.

Table 3: OIT Planning Unit Summaries (continued)

Planning Unit	
Metals Casting (continued)	
	MAJOR FINDINGS FOR PM Gating of Aluminum Permanent Mold Castings, **Die Materials for Critical Applications,** **Enhancements in Magnesium Die Casting,** **Optimization of the Squeeze Casting Process ,** **Predicting Pattern Tooling and Casting Dimensions for Investment Casting,** **Thin Wall Cast Iron** • Deliverables and milestones are reasonable and consistent with the projected commercialization date **In-Stream Inoculation for Aluminum Alloy Casting Processes,** **Reengineering of Steel Casting Manufacturing,** **Clean Steel: Mach. of Clean Cast Steel; and Accelerated Transfer of Clean Steel Technology,** **Systematic Microstructural & Corrosion Performance Evaluation** **Steel Foundry Refractory Lining Optimization: EAFs** • Deliverables and milestones seem reasonable, although details regarding the technology transfer process are lacking **Fast Response Measurements of Internal Die Cavity Temperatures** • Milestones for the bench-scale and full-scale demonstrations of the product seem reasonable. • Considering the uncertainties in the technology transfer process, a later market introduction date is more likely. We suggest 2002 as a more realistic date. **Casting Characteristics of Al Die Casting Alloys** • The steps and milestones leading to full commercialization are lacking. This makes the year of market introduction somewhat uncertain. In view of this, we suggest a later date such as 2002. **Mold Materials for Permanent Molding** • Deliverables seem reasonable, although details regarding the technology transfer process are lacking **Qualitative Reasoning for Diecasting Design Applications** • Deliverables and milestones are reasonable • The projected commercialization date of 2000 is somewhat aggressive. We recommend 2002 as a more likely date. **Non Incineration Treatment to Reduce Benzene** • The technical deliverables that will follow the laboratory and plant trials are not outlined. • Considering the uncertainties in the technology transfer process, a later market introduction date is more likely. We suggest 2002 as a more realistic date. **Yield Improvement in Steel Casting (Yield II)** • Deliverables seem reasonable, although details regarding the technology transfer process are lacking • Considering the uncertainties in the technology transfer process, a later market introduction date is more likely. We suggest 2002 as a more realistic date. **DOE RESPONSES AND ACTIONS** • Discussions were held with the metals casting planning unit and agreement was reached on the proposed changes to the energy usage numbers and market introduction dates.

Table 4: BTS Planning Unit Summaries

Planning Unit					
Commercial Buildings Integration					
	Total Primary Energy Displaced (Trillion Btus)				
	2000	**2005**	**2010**	**2015**	**2020**
Preliminary Draft	8.3	66.0	200.1	377.0	525.4
Final Submission	9.5	69.7	207.3	386.3	535.4

MAJOR FINDINGS FOR QM

- Overall, the DOE/BTS numbers seem reasonable. Increases from the Preliminary Draft to the Final Submission represent increases in the level of funding for this planning unit
- Savings are a combination of model energy code adoption and voluntary programs. Building codes were the primary method of achieving savings (represents 80% of the savings).
- The market penetration for Commercial Buildings Research and Development program is approximately 1% by 2020. This is conservative.
- The market penetration for Commercial Codes reaches a maximum of 36% by 2010. However, due to backsliding on adoption, market penetration drops down to 21% by 2020. This appears reasonable.
- A detailed account of the 30% energy savings shows a variety of activities, including:
  - building codes (which, according to DOE-2 simulation runs, reduce the energy used by 20%),
  - automated building systems (some studies have shown commercial buildings can save up to 10% or more of the energy used)
  - a new way of constructing buildings, using the “whole building” system approach at the design state so that all components of buildings are chosen to work together (e.g. proper sizing of equipment).
  - However, none of this is documented by technology or in detail, which would help in the evaluation.

MAJOR FINDINGS FOR PM

- The performance measures were provided through 2004. The review pertains only to these performance measures.
- All of the milestones and planned milestones deal with the adoption of building codes. Given that the majority of savings associated with the Planning Unit are through codes, these milestones appear appropriate and consistent with the goal of the Planning Unit.
- One planned activity would be to include a verification procedure to insure the Commercial Codes are being enforced and that the energy savings are being achieved.

DOE RESPONSES AND ACTIONS

- The findings have been discussed with Donna Hostick, PNL. It was agreed additional documentation should be provided by BTS.
- The reviewer agreed the BTS estimates appear reasonable, no revisions to the metrics were undertaken

Table 4: BTS Planning Unit Summaries (continued)

Planning Unit					
Residential Buildings Integration					
	Total Primary Energy Displaced (Trillion Btus)				
	2000	**2005**	**2010**	**2015**	**2020**
Preliminary Draft	1.5	37.8	125.2	230.2	322.9
Final Submission	1.6	39.6	131.2	242.0	340.7

MAJOR FINDINGS FOR QM

- Overall, the DOE/BTS numbers seem reasonable. Increases from the Preliminary Draft to the Final Submission represent increases in the level of funding for this Planning Unit
- Savings are a combination of residential energy code adoption and voluntary programs. The savings are distributed evenly.
- The GPRA submittal shows homes using 30% less energy in 1999 and 50% less energy in 2004 relative to typical homes in 1990.
- No technical justification for either the 30% or 50% has been offered. A list of technologies that can be universally applied needs to be documented to show the level of energy savings technically feasible. The 30% and 50% levels are not out of the realm of possibility, but they are aggressive and the actual path to these savings needs to be documented.
- The energy savings are assumed for space conditioning and water heating end-uses only, since no other measures or technologies are discussed. It is not clear from DOE's submittal what technologies provide savings (i.e. insulation, furnace, a combination, etc.).
- 70% market penetration by 2010 is a typographical error – it should be 10%. The 10%, as well as the 4% in 2004, would appear to be conservative estimates for market penetration.

MAJOR FINDINGS FOR PM

- Measures are consistent with goals for new construction, however they do not support the level needed for the savings projected in the QM.
- Additional measures for existing building stock, other than low-income housing, would paint a clearer picture of how the program's goals are going to be realized in this area.
- The program has a stated goal of 250,000 cumulative homes by 2004, yet when homes cited in the milestones section are summed, they represent one-tenth of 250,000. Better documentation is needed to justify the additional homes, but the number appears reasonable, since it represents approximately 4% of all homes constructed in this time period.

DOE RESPONSES AND ACTIONS

- The findings have been discussed with Donna Hostick, PNL. It was agreed additional documentation should be provided by BTS.
- The reviewer agreed the BTS estimates appear reasonable, no revisions to the metrics were undertaken.

Table 5: Final Planning Unit Submission

Planning Unit	Total Primary Energy Displaced (Trillion Btus)		
	2000	2010	2020
BTS			
Commercial Buildings Integration	10	207	535
Community Partnerships Program	8	225	434
Energy Star	3	106	210
Equipment, Materials & Tools	36	1,369	3,542
Residential Buildings Integration	2	131	341
State Energy Program	6	56	99
Technology Roadmaps and Competitive R&D	0	100	347
Weatherization Assistance Program	7	96	184
OIT			
Advanced Materials (CFCC and AIM)	0	93	237
Aluminum Vision	0	49	187
Chemicals Vision	0	151	830
Cogeneration - CHP	27	198	435
Forest & Paper Products Vision	0	194	1,508
Glass Vision	0	40	73
IAC	71	93	99
Integrated Delivery Program	27	158	331
Inventions & Innovations	112	107	117
Metals Casting Vision	0	20	77
NICE-3	19	109	144
Petroleum Refining Vision	0	218	340
Steel Vision	0	36	110
OPT			
Biomass Power R&D	28	422	533
Energy Storage	0	1	1
Geothermal Energy R&D	56	182	248
High Temperature Superconductivity	0	0	9
Hydrogen (Fuel Cell)	4	92	642
Hydropower	8	80	183
Open Solicitation	1	3	3
Photovoltaic Systems R&D	0	6	49
Power Systems Integration	23	124	132
Solar Buildings	3	30	112
Solar Thermal	0	4	29
Wind Energy R&D	20	207	613
OTT			
Advanced Automotive Technologies	0	639	1,589
Biofuels	0	360	1,001
Heavy Duty Vehicle Technologies	6	203	396
Transportation Materials Technology	0	12	50

The final FY2000 program impact estimates may differ in some cases from the "revised submissions" contained in Tables 1–4 due to increases in the FY2000 budget request since the revised numbers were estimated. In cases where a program did receive a FY2000 budget request increase, the revised submission served as the baseline for estimating the final program impact estimate.

Appendix C

Milestone and Metric Reports

DOE's Office of Energy Efficiency & Renewable Energy

GPRA2000 Goal, Resources & Milestones Report

Office of Build Tech, State, and Comm Progs (BTS)

BTS's Commercial Buildings Integration (FY99 Appropriation $4.908 million, FY2000 Request $5.825 million)

By 2004, as a result of the industry derived Commercial Buildings Road Map, the Commercial Buildings program will develop and demonstrate advanced technologies, in collaboration with the design and construction community, controls and equipment companies, developers, and building owners and operators, which will reduce energy consumption 30% compared to 1990 baselines. The commercial program focuses on advancing integrated technologies and practices to optimize whole building energy performance. Reducing the wasteful use of energy in commercial buildings makes those buildings more comfortable, improves the environment and increases the profits and productivity of businesses.

The Commercial Buildings program will also increase the baselines efficiency of the U.S. commercial building stock by supporting the upgrade of voluntary (model) building energy codes in partnership with the building industry consensus and model code organizations, states, code officials, design professions, builders, building product manufacturers, public interest groups, and utilities.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Carbon Equivalent Emissions Displaced (MMTCe)				.17	.23	.43	.63	.91	1.26	3.42	6.85	8.62
Total Primary Energy Displaced (Trillion Btu)				9.54	13.22	24.36	35.21	50.68	69.69	207.26	386.28	535.36
Energy Costs or Savings (Billions of $'s)				.06	.09	.16	.24	.35	.49	1.54	2.83	4.11

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)			.00	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83
Research (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Development (%)		.00	.00	.20	.20	.20	.20	.20	.20	.20	.20	.20
Deployment (%)		.00	.00	.80	.80	.80	.80	.80	.80	.80	.80	.80
Partner Financial Investment (Millions of $'s)	210.00		.00	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
Partner Non-Financial Investment (Millions of $'s)												
Partners (Number)			.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00

1997 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$1,400**

Commercial Building Codes: 4% of US construction with residential and commercial energy codes that meet or exceed MEC/90.1. 100,000 personnel training in 1997 on energy codes.

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$1,000**

Commercial Building Codes: Federal commercial code rule issued and residential NOPR issued

Year	Milestone Type	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	Description
ACCOMPLISHED				
1997	Other Milestones	$0	$3,800	Commercial Building Codes: Grants awarded to 23 States.
1998		$0	$0	Commercial Building Codes: 10 states being assisted in updating to IECC - early adoption version 90.1. Multiple states adopted with federal and matching funds.
		$0	$0	Commercial Building Codes: Put out federal commercial codes.
		$0	$0	Commercial Building Codes: Put out tools to simplify 90.1 compliance - ComCheck EZ and ComCheck plus.
PLANNED				
1999	Market Penetration Milestones	$21,500	$0	Commercial Building Codes: 78% of US construction with residential and commercial energy coded that meet or exceed MEC/90.1 and three states with coded that exceed by more than 10%. 20,000 personnel trained in 1999 on energy codes. MEC/90.1 updated, then continue maintenance - federal residential codes updated.
2000		$33,500	$0	Commercial Building Codes: 80% of US construction with residential and commercial energy codes that meet or exceed MEC/90.1 and four states with codes that exceed by more than 10%. 20,000 personnel trained in 2000 on energy codes. IECC updated.
2001		$45,500	$0	Commercial Building Codes: 80% of US construction with residential and commercial energy codes that meet or exceed MEC/90.1 and five states with codes that exceed by more than 10%. 40,000 personnel trained in 2001 on energy code.
2002		$57,500	$0	Commercial Building Codes: 80% of US construction with residential and commercial energy codes that meet or exceed MEC/90.1 and six states with coded that exceed by more than 10%. 40,000 personnel training in 2002 on energy codes.
2003		$69,500	$0	Commercial Building Codes: 80% of US construction with residential and commercial energy codes that meet or exceed MEC/90.1 and seven states with codes that exceed by more than 10%. 40,000 personnel trained in 2003 on energy codes. IECC updated.
2004		$81,500	$0	Commercial Building Codes: 80% of US construction with residential and commercial energy codes that meet or exceed MEC/90.1 and eight states with codes that exceed by more than 10%. 40,000 personnel trained in 1004 on energy codes.

BTS's Community Partnerships Program (FY99 Appropriation $33.44 million, FY2000 Request $30.4 million)

By 2004, in collaboration with local and regional partnerships, DOE community outreach activities will:

Leverage $6 billion in local investments,
Save over $1.3 billion/year in building energy costs,
Save over 2000 trillion Btus of energy,
and reduce carbon emissions by 3.2 MMTCE.

The Community Outreach program will (1) help communities form local partnerships, and develop action plans tailored to community needs; (2) coordinate delivery of multiple DOE programs and services while linking services with other Federal agencies, States, and national community associations; (3) provide information, technical assistance, analytical tools and training to support planning, financing (including volume purchasing), and implementation of building energy codes and projects; (4) award competitive grants to States and communities to provide staff support for comprehensive local actions addressing multiple energy and environmental concerns, e.g., affordable housing, school construction and renovation, municipal operations, utility deregulation, and implementation partnerships; (6) recognize and transfer successful approaches to other communities through peer exchange; (7) provide multiple avenues for education and training for diverse customer groups as well as the education community; and (8) assist States and communities to update the implement commercial and residential building codes.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Carbon Equivalent Emissions Displaced (MMTCe)				.13	.32	.60	.94	1.29	1.66	3.58	5.85	6.76
Total Primary Energy Displaced (Trillion Btu)				7.81	18.56	34.73	54.90	75.76	97.16	224.66	355.60	434.35
Energy Costs or Savings (Billions of $'s)				.05	.12	.23	.36	.49	.63	1.49	2.33	2.97

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)		.00	.00	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40	31.40
Research (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Development (%)		.00	.00	.09	.09	.09	.09	.09	.09	.09	.09	.09
Deployment (%)		.00	.00	.91	.91	.91	.91	.91	.91	.91	.91	.91
Partner Financial Investment (Millions of $'s)		.00	.00	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44
Partner Non-Financial Investment (Millions of $'s)				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Partners (Number)		.00	.00	254.00	304.00	354.00	404.00	404.00	504.00	754.00	4.00	4.00

1997 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Affordable Housing: Produced guidance materials and fact sheets (40%of budget), community and association partnerships (15% of budget), R&D, including on-site performance tests (15% of budget), and Training sessions and workshops (30% of budget).
Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$1,300**		Outreach: Initial stakeholder meetings for curriculum development for O&M training.
Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$200**		Rebuild America: Completed Action Plan Development Guide and Financing Guide for Rebuild America.

Year	Milestone Type	Cost		Description
		ACCOMPLISHED		
1997	Other Milestones	Estimated Cost (000 $'s):	**$0**	Rebuild America: Created 55 new Rebuild America Partnerships.
		Actual Cost (000 $'s):	**$1,000**	
1998		Estimated Cost (000 $'s):	**$0**	Affordable Housing: Produced guidance materials and fact sheets (40%of budget), community and association partnerships (15% of budget), R&D, including on-site performance tests (15% of budget), and Training sessions and workshops (30% of budget).
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$0**	Outreach: 'Energy Saver Tips' publication and updates.
		Actual Cost (000 $'s):	**$100**	
		Estimated Cost (000 $'s):	**$0**	Rebuild America: Created 55 new Rebuild America partnerships.
		Actual Cost (000 $'s):	**$1,000**	
		Estimated Cost (000 $'s):	**$0**	Rebuild America: Performance contracting training session with 3 states.
		Actual Cost (000 $'s):	**$15**	
		Estimated Cost (000 $'s):	**$0**	Rebuild America: Provide technical assistance to existing 180 Rebuild partnerships.
		Actual Cost (000 $'s):	**$3,000**	
		PLANNED		
1999	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$0**	Affordable Housing: 20% Habitat homes have 25% performance improvement, 5% CDCs improve building performance specifications.
		Actual Cost (000 $'s):	**$0**	
	Market Penetration Milestones	Estimated Cost (000 $'s):	**$0**	Outreach: Place success stories, case studies, and fact sheet on the Web, at the ERIC clearinghouse, and distributed to builders and trades networks.
		Actual Cost (000 $'s):	**$0**	
	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$455**	Outreach: (a) Update 'Energy Saver Tips' (Oct '98) (b) Produce 20 Fact Sheets and 20 Case Studies of BTS technologies (c) Produce Style and Editorial guide for Fact Sheets and Case Studies.
		Actual Cost (000 $'s):	**$0**	
	Market Penetration Milestones	Estimated Cost (000 $'s):	**$36,015**	Rebuild America: 55 additional Rebuild Partners for commitments of 440 million square feet, 250 total Rebuild partners for total commitments of 2,000 million square feet.
		Actual Cost (000 $'s):	**$0**	
2002		Estimated Cost (000 $'s):	**$70,000**	Rebuild America: 50 partners for commitments of 440 million square feet. Cumulative 400 partnerships with commitments to retrofit 3.2 million square feet.
		Actual Cost (000 $'s):	**$0**	

2004			**PLANNED**
	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Affordable Housing: Penetrate 1.2 million units (3%of total market) of households with incomes less than $25,000/year that are not receiving public assistance.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Affordable Housing: Penetrate 1 million units (25%of total market) of publicly assisted households.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Affordable Housing: 50% of Habitat new homes constructed to achieve 30% energy savings
		Estimated Cost (000 $'s): **$1,000** Actual Cost (000 $'s): **$0**	Rebuild America: Complete 'toolkit' for evaluation of commercial building retrofits using whole building approach.

BTS's Energy Star Program (FY99 Appropriation $7 million, FY2000 Request $5 million)

By 2004, 20% of all appliances sold will display the ENERGY STAR label, and 65% of all windows sold will qualify as ENERGY STAR. By 2004, the ENERGY STAR label will be widely recognized by consumers and building operators as the symbol for energy efficient appliances, windows, and commercial buildings, and homes.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Total Primary Energy Displaced (Trillion Btu)				2.82	7.49	15.85	26.41	37.84	50.12	106.44	161.45	210.29
Energy Costs or Savings (Billions of $'s)				.02	.05	.11	.19	.27	.37	.79	1.17	1.57
Carbon Equivalent Emissions Displaced (MMTCe)				.05	.14	.28	.46	.66	.87	1.67	2.65	3.14

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)				4.00	4.00	4.00	4.00	4.00	2.00	1.00	1.00	1.00
Research (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Development (%)		.00	.00	.30	.20	.20	.20	.20	.20	.20	.20	.20
Deployment (%)		1.00	1.00	.70	.80	.80	.80	.80	.80	.80	.80	.80
Partner Financial Investment (Millions of $'s)				30.00	30.00	30.00	30.00	30.00	30.00	.00	.00	.00
Partner Non-Financial Investment (Millions of $'s)				2.70	2.70	2.70	2.70	2.70	2.70	.00	.00	.00
Partners (Number)				75.00	100.00	125.00	150.00	175.00	200.00	.00	.00	.00

1997 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$75**

Energy Star: Added clothes washers and windows to portfolio of "Energy Star" products.

1998

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$1,100**

Energy Star: Launched "Energy Star" appliance labeling program in conjunction with national retail chains.

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$300**

Energy Star: Added 5 utilities as partners, added major appliance buyer as partner, and signed 3 manufacturing partners.

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$200**

Energy Star: Added windows to Energy Star.

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$100**

Energy Star: Completed consumer survey/collected sales data.

Year	Milestone type		PLANNED
1999	Market Penetration Milestones	Estimated Cost (000 $'s): **$25,100** Actual Cost (000 $'s): **$0**	Energy Star: Room AC ..... 395,000 Dishwasher... 471,000 Refrigerator. 566,000 Washers...... 908,000 Water Heaters 10,000
2000		Estimated Cost (000 $'s): **$31,400** Actual Cost (000 $'s): **$0**	Energy Star: Room A/C........ 679,000 Dishwasher...... 836,000 Refrigerator.... 1,003,000 Washers......... 1,610,000 Water Heaters... 50,000
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$500** Actual Cost (000 $'s): **$0**	Energy Star: Commercialize 'drop-in' heat pump water heater
2001		Estimated Cost (000 $'s): **$200** Actual Cost (000 $'s): **$0**	Energy Star: Incorporate "Energy Star" rating information into FTC label at the factory.

BTS's Equipment, Materials, and Tools (FY99 Appropriation $48.579 million, FY2000 Request $47.3 million)

By 2004, Equipment, Material and Tools activities will, in collaboration with industry and other interested parties, engage in a balanced program of research, development, and regulatory activities to promote the widespread adoption of energy-efficient products and technologies in residential and commercial buildings. In close collaboration with industry and other interested parties, the program will conduct research, development and deployment activities to provide industry with the advanced technology base needed for highly-efficient globally competitive building components (equipment, envelope subsystems, materials, and design and energy simulation tools) and to accelerate the adoption and widespread use of these advanced technologies within both residential and commercial buildings. In addition, the program will implement regulatory activities to increase the baseline efficiency of certain regulated residential appliances, commercial and industrial equipment through a program consisting of test procedures and energy conservation standards.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Total Primary Energy Displaced (Trillion Btu)				35.69	58.88	102.87	185.72	317.55	468.56	1368.99	2465.48	3541.58
Energy Costs or Savings (Billions of $'s)				.30	.47	.80	1.38	2.28	3.35	9.73	16.63	23.77
Carbon Equivalent Emissions Displaced (MMTCe)				.77	1.23	2.06	3.50	5.76	8.36	21.23	39.16	49.55

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)				49.30	48.80	46.70	46.90	48.40	47.20	43.10	39.00	25.70
Research (%)				.45	.45	.40	.40	.40	.40	.45	.45	.40
Development (%)				.20	.20	.20	.20	.20	.20	.20	.20	.20
Deployment (%)				.35	.35	.40	.40	.40	.40	.35	.35	.40
Partner Financial Investment (Millions of $'s)				17.80	20.90	68.90	69.70	70.10	70.70	19.40	31.40	50.40
Partner Non-Financial Investment (Millions of $'s)				14.90	19.90	26.00	41.00	51.00	76.00	9.00	14.00	22.00
Partners (Number)				212.00	359.00	531.00	934.00	1320.00	2122.00	113.00	117.00	121.00

1997 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s)	Actual Cost (000 $'s)	Milestone
$0	**$1,800**	Cogeneration/Fuel Cells: Three cost-shared contracts awarded.
$0	**$0**	Fan atomized burner: Field demonstration of U.L.-listed Fan Atomization burner.
$0	**$0**	Lighting & Appliance Standards: Refrigerator final rule, April, 1997. Clothes Washer test procedure final rule, July, 1997.
$0	**$0**	Lighting R&D: Commercial sales of Light Drive 1000. Production goal of 90 Lumens/Watt exceeded. Dimming Ballast for Light Drive 1000 developed and enters marketplace. Provides computer control of dimming down to 20% -- an industry first. Novel, inexpensive light pipe technology developed for industrial, high bay, HPSL demonstrations.
$0	**$3,000**	Lighting R&D: Fusion demonstrates ability to power LPSL using solid state devices in a laboratory (nsp). Fusion Lighting's Light Drive 1000 named most technically innovative product of 1998 in the US Lighting Industry (3M).

1997 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s)	Actual Cost (000 $'s)	Milestone
$0	$500	Lighting R&D: GE provides first progress report of development of low-cost CFL.
$0	$80	Lighting R&D: LRC initiates research on mesopic lighting for roadway applications.
$0	$50	Lighting R&D: National Design Competition (Millennium Design Challenge) planning phase complete.
$0	$15,000	Natural gas absorption heat pumps: Completed prototype design of residential unit.
$0	$2,000	Natural gas absorption hi-cool heat pump: Completed design of bench-scale components and initiated testing
$0	$1,500	Reflectivity Research: Complete computer modeling of UHI effects in 6 major cities.
$0	$0	Reflectivity Research: Published guidebook or tested cool materials for consumers, product manufacturers, and retailers.
$0	$6,000	Super Windows: Completed durability testing of electrochromic glazing samples.
$0	$4,000	Super Windows: Completed updated versions of Therm, WINDOW, and RESFEN performance modeling tools.
$0	$100	Super Windows: Establish formal partnership with Alliance to Save Energy to administer Efficient Window Collaborative.
$0	$0	Supermarket Refrigeration/HVAC: Completed tests of optimized LOF refrigeration system for vending machines.

1998 Other Milestones

ACCOMPLISHED

Cost		Milestone
Estimated Cost (000 $'s):	**$0**	Advanced desiccants: Development of sensors/controls uniquely suited to desiccant systems.
Actual Cost (000 $'s):	**$100**	
Estimated Cost (000 $'s):	**$0**	Advanced desiccants: Figure of Merit established.
Actual Cost (000 $'s):	**$350**	
Estimated Cost (000 $'s):	**$0**	Advanced desiccants: Quantify benefits of ventilation/humidity controls in schools.
Actual Cost (000 $'s):	**$300**	
Estimated Cost (000 $'s):	**$0**	Cogeneration/Fuel Cells: Complete Phase I design competition for methane reformer for 50-kW PEM fuel cell.
Actual Cost (000 $'s):	**$2,000**	
Estimated Cost (000 $'s):	**$0**	Cogeneration/Fuel Cells: Facilitated implementation of process to develop applicable Codes and Standards.
Actual Cost (000 $'s):	**$50**	
Estimated Cost (000 $'s):	**$0**	Fan atomized burner: Advanced (Fan atomized) Prototype demonstration of 1st Generation low-Nox burner.
Actual Cost (000 $'s):	**$500**	
Estimated Cost (000 $'s):	**$0**	Fan Atomized Burner: Fan Atomization Burner introduced
Actual Cost (000 $'s):	**$0**	
Estimated Cost (000 $'s):	**$0**	Natural gas absorption heat pumps: Initiated fabrication of complete GAX prototype heat pump with small business manufacturer.
Actual Cost (000 $'s):	**$19,000**	
Estimated Cost (000 $'s):	**$0**	Natural gas absorption hi-cool heat pump: Moved from bench-scale component development to laboratory breadboard component integration.
Actual Cost (000 $'s):	**$2,500**	
Estimated Cost (000 $'s):	**$0**	Reflectivity Research: Added 4 cities as participants in cool communities program. Cool Roof Rating Council established for rating and labeling reflectivity of roofs and pavements.
Actual Cost (000 $'s):	**$0**	
Estimated Cost (000 $'s):	**$0**	Reflectivity Research: Data base of 100 qualifying products for mitigating UHI effects.
Actual Cost (000 $'s):	**$1,800**	

Year	Milestone Type	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	Description
ACCOMPLISHED				
1998	Other Milestones	**$0**	**$0**	Super Insulating Materials: Performed structural testing of very low cost insulated wall (QuickFill wall). Initiated testing of non-HCFC foam insulations.
		$0	**$1,200**	Super Windows: THERM 2.0 released.
		$0	**$1,000**	Super Windows: Upgrade of DOE 2 engine for ResFen.
		$0	**$0**	Supermarket refrigeration/HVAC: Completed experimental verification of high-glide zeotrope benefit in air conditioners.
PLANNED				
1999	Market Penetration Milestones	**$300**	**$0**	Commercial Design Strategy: IPMVP (International Performance Measurement and Verification Protocol) International Measure & Verification Protocol Institutes.
		$4,802	**$0**	Lighting & Appliance Standards: Commercial - Conduct preliminary engineering analysis and develop Technical Support Document.
		$0	**$0**	Lighting & Appliance Standards: Residential - Clothes washer final rule. Water heaters final rule. Fluorescent lamp ballasts final rule.
	Technology Characteristic Milestones	**$96**	**$0**	Lighting & Appliance Standards: Commercial - Storage water heaters - Certification and Labeling (Final Rule).
		$176	**$0**	Lighting & Appliance Standards: Commercial - Packaged boilers - Test Procedure Rule (NOPR).
		$44	**$0**	Lighting & Appliance Standards: Commercial -- Instantaneous water heaters -- Test Procedure rule (NOPR).
		$96	**$0**	Lighting & Appliance Standards: Commercial -- Packaged Boilers -- Certification and labeling (final rules).

Year	Milestone Type	PLANNED		
1999	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$44** Actual Cost (000 $'s): **$0**		Lighting & Appliance Standards: Commercial - Unfired storage tanks - Certification and Labeling Rule (NOPR).
		Estimated Cost (000 $'s): **$48** Actual Cost (000 $'s): **$0**		Lighting & Appliance Standards: Commercial - Instantaneous water heaters - Certification and Labeling (Final Rule).
		Estimated Cost (000 $'s): **$96** Actual Cost (000 $'s): **$0**		Lighting & Appliance Standards: Commercial - Warm Air Furnaces - Certification and Labeling (Final Rule).
		Estimated Cost (000 $'s): **$193** Actual Cost (000 $'s): **$0**		Lighting & Appliance Standards: Commercial - Small and large package air-conditioning and heating equipment. Certification and Labeling (Final Rule)
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Lighting & Appliance Standards: FY 2000 input is being collected using the stanimp.wk4 spreadsheet. 1.5 M per rule, over three years.
		Estimated Cost (000 $'s): **$88** Actual Cost (000 $'s): **$0**		Lighting & Appliance Standards: Test procedure rule (NOPR).
		Estimated Cost (000 $'s): **$48** Actual Cost (000 $'s): **$0**		Lighting & Appliance Standards: Test procedure development (ASHRAE).
	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Lighting R&D: 1000 Watt S-Lamp achieves critical sales (>10,000 units)
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$1,800** Actual Cost (000 $'s): **$0**		Lighting R&D: 1. Field test of 75 lumen/watt low-power sulfur lamp. (500 k). 2. Control systems prototype (1M). 3. Hi-Power Sulfur lamp electric power source improvement of 135 lumen/watt (300k).
		Estimated Cost (000 $'s): **$4,650** Actual Cost (000 $'s): **$0**		Natural gas absorption hi-cool heat pumps: Construct and test laboratory prototypes of natural gas absorption hi-cool heat pumps.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Reflectivity Research: Add four more cities or Federal sites (e.g., military bases) as participants.

Year	Milestone Type	Cost		PLANNED
1999	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$150**	Reflectivity Research: Modification of Res ASHRAE Standard 90.2 to incorporate reflective surfaces.
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$150**	Reflectivity Research: Modification of Res ASHRAE Standard 90.2 to incorporate reflective surfaces.
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$1,100**	Super Insulating Materials: Establish whole-wall testing and rating system for insulations (1M). Develop very low cost sustainable insulated wall systems. (QuickFill wall) (100k).
		Actual Cost (000 $'s):	**$0**	
	Market Penetration Milestones	Estimated Cost (000 $'s):	**$4,000**	Super Windows: Participation by manufacturers participating in the Efficient Window Collaborative.
		Actual Cost (000 $'s):	**$0**	
	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$1,000**	Super Windows: Major upgrade of ResFen and Annual energy performance ratings. This milestone is part of Energy Performance Research that supports the development of improved 'windows.' This includes THERM (heat transfer software), ResFen (Residential Fenestration software), ComFen (Commercial Fenestration software), and Optics 5. These programs also support design, ratings and deployment efforts.
		Actual Cost (000 $'s):	**$0**	
2000		Estimated Cost (000 $'s):	**$900**	Supermarket Refrigeration/HVAC: Lab demonstration of advanced air-to-air air-conditioning system using a chlorine free refrigerant that exhibits high temperature cooling efficiencies at least 15% better than current technology (CRADA w/ Dupont)
		Actual Cost (000 $'s):	**$0**	
	Market Penetration Milestones	Estimated Cost (000 $'s):	**$3,500**	Commercial Design Strategies: All new homes built to ASHRAE 119 or Energy Star guidelines.
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$800**	Commercial Design Strategy: IAQ Worker Productivity Synthesis of results.
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$6,302**	Lighting & Appliance Standards: Commercial - Issue ANOPR
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$0**	Lighting & Appliance Standards: Residential -- Room AC, projected effective date
		Actual Cost (000 $'s):	**$0**	
	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$431**	Lighting & Appliance Standards: Commercial - Warm Air Furnaces - Develop Technical Support Document for Efficiency Standard Rule.
		Actual Cost (000 $'s):	**$0**	

Year	Milestone Type	Cost	Amount	PLANNED
2000	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$862** **$0**	Lighting & Appliance Standards: Commercial - Small and large package air-conditioning and heating equipment. Develop Technical Support Document for Efficiency Standard Rule.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$451** **$0**	Lighting & Appliance Standards: Commercial -- Small and large package air-conditioning and heating equipment -- Efficiency Standard Rule (ANOPR).
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$233** **$0**	Lighting & Appliance Standards: Commercial - Warm Air Furnaces - Efficiency Standard Rule (ANOPR)
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$63** **$0**	Lighting & Appliance Standards: Commercial - Unfired storage tanks - Test Procedure Rule (Final Rule).
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$63** **$0**	Lighting & Appliance Standards: Commercial - Instantaneous water heaters - Test procedure Rule (Final Rule)
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$125** **$0**	Lighting & Appliance Standards: Commercial - Storage water heaters - Test Procedure Rule (Final Rule).
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$915** **$0**	Lighting & Appliance Standards: Commercial - Packaged boilers - Efficiency Standard Rule. (ANOPR) ($232,872). Test procedure rules (final rules) ($250,854). Develop technical support document for efficiency standard rule ($431,185).
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$0** **$0**	Lighting & Appliance Standards: Residential Central air conditioners and heat pumps Proposed Rule. Residential clothes washer final rule.
	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$0** **$0**	Lighting R&D: 1000 Watt S-Lamp Sales Double (>20,000 units)
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$1,750** **$0**	Lighting R&D: Demo of low-cost GE CFL
	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$0** **$0**	Reflectivity Research: Add four more cities or Federal sites (e.g., military bases) as participants.

Year	Milestone Type	Cost	PLANNED
2000	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$1,000** Actual Cost (000 $'s): **$0**	Reflectivity Research: 75 cities participating in cool communities program.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$250** Actual Cost (000 $'s): **$0**	Residential Design Strategies: ASHRAE 62.2 Adopted.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$200** Actual Cost (000 $'s): **$0**	Super Insulating Material: Construct building prototype structures out of very low-cost sustainable insulation materials.
		Estimated Cost (000 $'s): **$60** Actual Cost (000 $'s): **$0**	Super Insulating Material: Estimate energy savings associated with radiation control coatings based on measurements and modeling.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$1,250** Actual Cost (000 $'s): **$0**	Super Insulating Materials: Construct two prototype house envelopes with very low-cost insulation materials. State of California acceptance of whole wall labeling program.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Super Windows: First electrochromic windows become commercially available for niche market (in proprietary applications). (estimated cost unknown)
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$6,000** Actual Cost (000 $'s): **$0**	Super Windows: Complete scale-up of electrochromic window.
2001		Estimated Cost (000 $'s): **$7,500** Actual Cost (000 $'s): **$0**	Cogeneration/Fuel Cells: Prototype natural gas fuel processor for 'first generation' fuel cell.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$350** Actual Cost (000 $'s): **$0**	Commercial Design Strategies: ASHRAE 62.1 on Commercial Ventilation is Issued.
		Estimated Cost (000 $'s): **$7,802** Actual Cost (000 $'s): **$0**	Lighting & Appliance Standards: Commercial - Issue NOPR
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Lighting & Appliance Standards: Residential - Refrigerators/Freezers, effective July 2001.

2001		PLANNED		
	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$149**	Lighting & Appliance Standards: Commercial - Unfired storage tanks - Efficiency Standard Rule (ANOPR).
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$272**	Lighting & Appliance Standards: Commercial - Unfired storage tanks - Develop Technical Support Document for Efficiency Standard Rule.
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$272**	Lighting & Appliance Standards: Commercial - Instantaneous water heaters - Develop Technical Support Document for Efficiency Standard Rule.
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$149**	Lighting & Appliance Standards: Commercial - Instantaneous water heaters - Efficiency Standard Rule (ANOPR).
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$232**	Lighting & Appliance Standards: Commercial - Warm Air Furnaces - Efficiency Standard Rule (NOPR).
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$298**	Lighting & Appliance Standards: Commercial - Storage water heaters - Efficiency Standard Rule (ANOPR).
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$551**	Lighting & Appliance Standards: Commercial - Small and large package air-conditioning and heating equipment. Efficiency Standard Rule (NOPR).
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$431**	Lighting & Appliance Standards: Commercial - Storage water heaters - Develop Technical Support Document for Efficiency Standard Rule.
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$283**	Lighting & Appliance Standards: Commercial - Packaged boilers - Efficiency Standard Rule (NOPR).
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$0**	Lighting & Appliance Standards: Residential Central air conditioners and heat pumps Final Rule.
		Actual Cost (000 $'s):	**$0**	
	Market Penetration Milestones	Estimated Cost (000 $'s):	**$150**	Lighting R&D: National design contest for Energy Efficient fixture - implementation phase
		Actual Cost (000 $'s):	**$0**	

			PLANNED
2001	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Reflectivity Research: Add four more cities or Federal sites (e.g., military bases) as participants.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$230** Actual Cost (000 $'s): **$0**	Reflectivity Research: Establish standardized procedures for labeling reflectivity of roofs.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$50** Actual Cost (000 $'s): **$0**	Super insulating materials: Code acceptance of QuickFill wall in one state.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$400** Actual Cost (000 $'s): **$0**	Super Insulating Materials: Develop procedures and protocols for moisture tolerance of wall systems.
		Estimated Cost (000 $'s): **$6,000** Actual Cost (000 $'s): **$0**	Super Windows: Field tests of (scaled-up) full size electrochromic windows.
		Estimated Cost (000 $'s): **$300** Actual Cost (000 $'s): **$0**	Supermarket Refrigeration/HVAC: Reduce energy consumption of soft-drink vending machines and display cases (reach in refrigerators) by 20% (CRADA with Cavalier Corp.)
2002	Market Penetration Milestones	Estimated Cost (000 $'s): **$14,800** Actual Cost (000 $'s): **$0**	Advanced Desiccants: Advanced solids systems introduced
		Estimated Cost (000 $'s): **$7,500** Actual Cost (000 $'s): **$0**	Cogeneration/Fuel Cells: Potential market introduction of a natural gas reformer for PEM cells.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$500** Actual Cost (000 $'s): **$0**	Cogeneration/Fuel Cells: Operate the prototype natural gas fuel processor for a 50 kW EM fuel cell. Complete design for a first-generation 50 kW PEM fuel cell for light-commercial building applications.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Commercial Design Strategies: 20% of designers are using computerized IAQ and ventilation tools for commercial buildings.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Fan Atomized Burner: Commercial marketing partner for self-tuning burner identified.

Year	Milestone Type	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	PLANNED
2002	Technology Characteristic Milestones	$1,000	$0	Fan Atomized Burner: Self-tuning burner research completed. Demonstration for manufacturer.
	Market Penetration Milestones	$9,802	$0	Lighting & Appliance Standards: Commercial - Issue Final Rule
	Technology Characteristic Milestones	$751	$0	Lighting & Appliance Standards: Commercial - Small and large package air-conditioning and heating equipment. Efficiency Standard Rule (Final Rule).
		$199	$0	Lighting & Appliance Standards: Commercial - Unfired storage tanks - Efficiency Standard Rule (NOPR).
		$383	$0	Lighting & Appliance Standards: Commercial - Warm Air Furnaces - Efficiency Standard Rule (Final Rule)
		$199	$0	Lighting & Appliance Standards: Commercial - Instantaneous water heaters - Efficiency Standard Rule (NOPR).
		$383	$0	Lighting & Appliance Standards: Commercial - Packaged boilers - Efficiency Standard Rule (Final Rule).
		$398	$0	Lighting & Appliance Standards: Commercial - Storage water heaters - Efficiency Standard Rule (NOPR).
	Market Penetration Milestones	$1,750	$0	Lighting R&D: low-cost CFLs enter the marketplace (all cost are associated with the development and demonstration of the low-cost sulfur lamp completed in the year 2000)
		$30,000	$0	Natural Gas Absorption Heat Pumps: Begin market conditioning for residential unit.
	Technology Characteristic Milestones	$0	$0	Natural gas absorption heat pumps: Complete field testing of GAX engineering prototype unit

Year	Milestone Type	PLANNED		
2002	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Reflectivity Research: Add four more cities or Federal sites (e.g., military bases) as participants.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$2,000** Actual Cost (000 $'s): **$0**		Relfectivity Research: 150 cities participating in cool communities program.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$750** Actual Cost (000 $'s): **$0**		Super Insulating Materials: 500 R-30/30 year roofs installed on small commercial facilities.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$1,000** Actual Cost (000 $'s): **$0**		Super Insulating Materials: Develop energy efficient steel framed structures (750K). Develop termite resistant energy efficient foundation walls and slabs (250K).
		Estimated Cost (000 $'s): **$1,000** Actual Cost (000 $'s): **$0**		Supermarket Refrigeration/HVAC: Reduce first cost through simplified installation of a air-to-air water heater that uses 50% less primary energy than electric resistance units.
2003	Market Penetration Milestones	Estimated Cost (000 $'s): **$16,300** Actual Cost (000 $'s): **$0**		Advanced Desiccants: Advanced liquids systems introduced.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$1,500** Actual Cost (000 $'s): **$0**		Commercial Design Strategies: 'Diagnostician' whole building analysis tool commercially available.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$11,602** Actual Cost (000 $'s): **$0**		Lighting & Appliance Standards: Commercial - 5% per year based on a 20 year life.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Lighting & Appliance Standards: Residential - Water heater, projected effective date.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$244** Actual Cost (000 $'s): **$0**		Lighting & Appliance Standards: Commercial - Instantaneous water heaters - Efficiency Standard Rule (Final Rule).
		Estimated Cost (000 $'s): **$244** Actual Cost (000 $'s): **$0**		Lighting & Appliance Standards: Commercial - Unfired storage tanks - Efficiency Standard Rule (Final Rule)

Year	Milestone type	Cost	PLANNED
2003	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$488** Actual Cost (000 $'s): **$0**	Lighting & Appliance Standards: Commercial - Storage water heaters - Efficiency Standard Rule (Final Rule)
		Estimated Cost (000 $'s): **$30,000** Actual Cost (000 $'s): **$0**	Natural Gas Absorption Heat Pump: Initiate design and development of a pre-production prototype.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$31,000** Actual Cost (000 $'s): **$0**	Natural Gas Absorption Heat Pumps: Market introduction of residential heat pumps.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$13,450** Actual Cost (000 $'s): **$0**	Natural Gas Absorption Hi-Cool Heat Pump: Initiate design and fabrication of engineering prototype and begin testing.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Reflectivity Research: Add four more cities or Federal sites (e.g., military bases) as participants.
		Estimated Cost (000 $'s): **$1,350** Actual Cost (000 $'s): **$0**	Super Insulating Materials: 2 Energy efficient steel framed structures (1M). 2 Termite resistant energy efficient foundation walls and slabs (350K).
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$2,500** Actual Cost (000 $'s): **$0**	Super Insulating Materials: Develop non-HCFC foam insulations with R-5 per inch.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$2,000** Actual Cost (000 $'s): **$0**	Super Windows: Test market of electrochromic window (BTS provides technical support).
2004		Estimated Cost (000 $'s): **$18,300** Actual Cost (000 $'s): **$0**	Advanced Desiccants: Achieve 8% market penetration (total of both systems).
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$3,000** Actual Cost (000 $'s): **$0**	Cogeneration/Fuel Cells: Begin fabrication of a first-generation PEM fuel cell system.
		Estimated Cost (000 $'s): **$500** Actual Cost (000 $'s): **$0**	Fan Atomized Burner: Completion and demonstration of a computational fluid dynamics model for low-NOx burner with manufacturer participation.

Year	Milestone Type	PLANNED		
2004	Market Penetration Milestones	Estimated Cost (000 $'s): **$11,602** Actual Cost (000 $'s): **$0**		Lighting & Appliance Standards: Commercial - 10% per year based on a 20 year life.
		Estimated Cost (000 $'s): **$4,000** Actual Cost (000 $'s): **$0**		Lighting R&D: 1000 Watt S-Lamp Sales Exceed 100,000 units LPSL enter the marketplace
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$31,000** Actual Cost (000 $'s): **$0**		Natural Gas Absorption Heat Pumps: Complete field testing of multiple pre-production prototypes.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Reflectivity Research: Add four more cities or Federal sites (e.g., military bases) as participants.
		Estimated Cost (000 $'s): **$3,000** Actual Cost (000 $'s): **$0**		Super Insulating Materials: Non-HCFC foam insulations in marketplace.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$5,000** Actual Cost (000 $'s): **$0**		Super Insulating Materials: Develop cost effective superinsulations for building envelopes, refrigerators, freezers and rooftop air-conditioning equipment.
2005		Estimated Cost (000 $'s): **$1,200** Actual Cost (000 $'s): **$0**		Fan Atomized Burner: 2nd Generation low-NOx (fan atomized) burner.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Natural Gas Absorption Hi-Cool Heat Pump: Residential absorption Hi-Cool heat pump introduced.
		Estimated Cost (000 $'s): **$5,200** Actual Cost (000 $'s): **$0**		Super Insulating Materials: Develop cost effective superinsulations for building envelopes, refrigerators, freezers, and rooftop air-conditioning equipment.

BTS's Residential Buildings Integration (FY99 Appropriation $12.805 million, FY2000 Request $13.038 million)

The Residential Buildings program, in continued collaboration with the original Building America consortia and other major players in the homebuilding industry, will use a whole building systems approach to optimally integrate building components, resulting in new homes that will typically consume 50 percent less energy in 2004 than typical homes built in 1990. Improving energy efficiency makes homes more comfortable, improves the local environment, and increases the discretionary income of homeowners. The Residential Buildings program will provide the necessary leadership to achieve the goal of transferring these major systems innovations directly and indirectly to an accumulated total of 250,000 homes by 2004, and into 10 percent of all new homes by 2010. To reach this goal, the Residential Buildings program will use R&D and regulatory strategies for new homes and outreach and education for existing homes.

The development of Residential Building Standards and Guidelines will help increase the baseline efficiency of the U.S. residential building stock by supporting the upgrading of voluntary (model) building energy codes in partnership with the building industry consensus and model code organizations, states, code officials, design professions, builders, building product manufactures, public interest groups, and utilities. In addition to supporting the upgrade of the model code, DOE will promulgate updated Federal residential building energy codes, develop and upgrade core tools and materials, and provide technical and financial support of states to update their energy codes.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Carbon Equivalent Emissions Displaced (MMTCe)				.03	.09	.18	.31	.49	.70	2.17	4.16	5.50
Total Primary Energy Displaced (Trillion Btu)				1.61	4.89	10.08	17.36	27.37	39.60	131.23	242.03	340.72
Energy Costs or Savings (Billions of $'s)				.01	.03	.07	.12	.20	.29	.99	1.79	2.60

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)			.00	13.04	13.04	13.04	13.04	13.04	13.04	13.04	.68	.68
Research (%)		.00	.00	.45	.55	.60	.60	.60	.60	.60	.00	.00
Development (%)		.00	.00	.55	.40	.35	.35	.35	.35	.35	.20	.20
Deployment (%)		.00	.00	.05	.05	.05	.05	.05	.05	.05	.80	.80
Partner Financial Investment (Millions of $'s)	8.00		.00	6.00	8.00	10.00	12.00	14.00	16.00	26.00	.00	.00
Partner Non-Financial Investment (Millions of $'s)			.00	.50	.75	1.00	1.25	1.50	1.75	2.00	.00	.00
Partners (Number)			124.00	90.00	100.00	105.00	110.00	115.00	120.00	125.00		

1997 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$0**

Industrialized Housing: Began Construction of 2 advanced 'entry-level' houses, Completed 2 advanced manufactured houses, 2 SIP houses, and begin monitoring energy performance and indoor air quality.

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$0**

Industrialized Housing: Construction of at least 200 homes by affiliates of Habitat for Humanity in FL, KY, OH, VA, NY, GA and TX. EEIH staff suggested energy improvements and monitored the construction in most including leading the energy construction features in the 100 home Jimmy Carter work project in Houston, TX during June 1998.

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$0**

Industrialized Housing: Construction of at least 1,700 homes by Palm harbor Homes factories in Florida and North Carolina incorporating airtight duct construction technology transfer to Palm harbor by EEIH staff.

Year	Milestone Type	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	Description
ACCOMPLISHED				
1997	Other Milestones	$0	$0	Industrialized Housing: Construction of two high visibility demonstration homes in partnership with ALA Washington (in Seattle) and ALA central Florida (in Orlando) Completion of 1 year monitoring on 4 "Heathly Houses" and 4 other base case houses
		$0	$0	Industrialized Housing: Marketplace acceptance of FanRecyler technology. Over 200 FanRecyclers installed in Building America homes.
1998		$0	$0	Industrialized Housing: Complete one-year monitoring of six homes built in 1997. Publish results.
		$0	$0	Industrialized Housing: Develop partnerships with housing manufacturers and construct additional four advanced EE/IAQ homes in different regions of U.S. Complete construction of three entry level homes in central Florida.
		$0	$0	Industrialized Housing: In partnership with ALA Washington construct 6 improved EE/IAQ homes.
		$0	$0	Industrialized Housing: Incorporate Fan Recyclers in additional 200 homes. Develop steel/wood framing members which do not exhibit thermal bridging. Begin a program with the National Manufactured Housing Alliance to look at moisture problems in manufactured homes.
		$0	$0	Industrialized Housing: Work with Palm Harbor homes to incorporate airtight duct systems in a total of five factories and manufacture at least 2,000 homes with improved duct systems.
		$0	$0	Industrialized Housing: Work with affiliates of Habitat for Humanity in constructing at least 100 energy efficient Habitat homes.
PLANNED				
1999	Market Penetration Milestones	$600		Building America: Begin three large community-scale developments (Summerset, Civano & Playa Vista). Expand regional builder members of industry teams to complement membership by large national builders. Initiate participation in 4 additional subdivision-scale projects. Complete 4 case studies on Building America solutions (1 for each team)
	Technology Characteristic Milestones	$11,900		Building America: 30% average reduction in Building America house space conditioning and water heating energy use.
	Market Penetration Milestones	$0	$0	Industrialized Housing: Building Science Consortium and other Building America consortiums use FanRecyclers and other innovations from EEIH project in at least 200 homes in cold climates.

Year	Milestone Type	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	PLANNED
1999	Market Penetration Milestones	$0	$0	Industrialized Housing: EEIH staff works with at least 5 affiliates of Habitat for Humanity and improves the energy efficiency of at least 150 constructed homes throughout the U.S.
		$0	$0	Industrialized Housing: Monitoring is planned on 36 homes of Centex corp. using insulated concrete for and conventional technology in Dallas TX, 3 entry level homes in central Florida and 3 Habitat homes in Georgia using energy efficient factory built components.
		$0	$0	Industrialized Housing: Palm Harbor homes produces at least 3,000 homes with improved air distribution ducts using technology suggested by and training conducted by the EEIH program in factories in Florida, North Carolina, Oregon and Ohio.
	Technology Characteristic Milestones	$0	$0	Industrialized Housing: Assist habitat for Humanity in evaluating the applicability of Structural Insulated Panel construction for Habitat construction.
		$0	$0	Industrialized Housing: Complete synoptic review of lessons learned in industrialized housing field.
		$0	$0	Industrialized Housing: Publish energy and IAQ results from monitoring effort of 3 'entry-level' industrialized homes in Florida in 'Professional Builder' magazine. Publish energy testing and monitoring results from two SIP homes in Georgia and one in Washington in collaboration with Habitat, SIPA and APA.
	Market Penetration Milestones	$0	$0	Residential Buildings Codes: For information on Residential Buildings Codes milestones, see Commercial Buildings Integration milestones, Commercial Buildings Codes.
2000		$1,200		Building America: A total of 2,000 homes will have been constructed since program inception as direct result of 4 consortia.
	Technology Characteristic Milestones	$23,800		Building America: 34% average reduction in Building America house space conditioning and water heating energy use.
	Market Penetration Milestones	$0	$0	Industrialized Housing: Building Science Consortium and other Building Aerica consortiums use FanRecyclers and other innovations from EEIH project in at least 200 homes in cold climates.
		$0	$0	Industrialized Housing: EEIH staff works with at least 4 affiliates of habitat for Humanity and improves the energy efficiency of at least 100 constructed homes throughout the U.S.

Year	Milestone Type	PLANNED		
2000	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: New industry partnerships are formed and additional houses constructed and tested.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: Palm Harbor homes produces at least 3,000 homes with improved air distribution ducts using technology suggested by the training conducted by the EEIH program in factories in Florida, North Carolina, Oregon and Ohio.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: Web pages, papers and guidelines are developed to transfer the technologies domestically and internationally.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: Create a U.S. map showing the energy, peak load and IAQ impacts of Insulated Form Construction technology. Validate map with data from constructed houses. Create a ventilation effectiveness map of the U.S.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: Two ventilation and IAQ controls patented. At least 500 building America homes will incorporate this control technology predominantly in cold and hot-dry climates
	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Residential Buildings Codes: For information on Residential Buildings Codes milestones, see Commercial Buildings Integration milestones, Commercial Buildings Codes.
2001		Estimated Cost (000 $'s): **$1,800** Actual Cost (000 $'s):		Building America: Another 400 homes will be constructed as direct result of 4 Building America consortia.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$35,700** Actual Cost (000 $'s):		Building America: 38% average reduction in Building America house space conditioning and water heating energy use.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: Building Science Consortium and other Building Aerica consortiums use FanRecyclers and other innovations from EEIH project in at least 200 homes in cold climates.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: EEIH staff works with at least 4 affiliates of habitat for Humanity and improves the energy efficiency of at least 100 constructed homes throughout the U.S.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: New industry partnerships are formed and additional houses constructed and tested.

2001	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: Palm Harbor homes produces at least 3,000 homes with improved air distribution ducts using technology suggested by the training conducted by the EEIH program in factories in Florida, North Carolina, Oregon and Ohio.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: Transfer proven technological innovations to the Building America consortia teams for potential adoption in new construction.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: Web pages, papers and guidelines are developed to transfer the technologies domestically and internationally.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: DOE to make specific recommendations on operating processes/techniques to measurably improve indoor air quality, e.g. dust mites and other allergens.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Residential Buildings Codes: For information on Residential Buildings Codes milestones, see Commercial Buildings Integration milestones, Commercial Buildings Codes.
2002		Estimated Cost (000 $'s): **$2,400** Actual Cost (000 $'s):		Building America: Another 700 homes will be constructed as direct result of 4 consortia.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$47,600** Actual Cost (000 $'s):		Building America: 42% average reduction in Building America house space conditioning and water heating energy use.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: Building Science Consortium and other Building Aerica consortiums use FanRecyclers and other innovations from EEIH project in at least 200 homes in cold climates.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: EEIH staff works with at least 4 affiliates of habitat for Humanity and improves the energy efficiency of at least 100 constructed homes throughout the U.S.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: New industry partnerships are formed and additional houses constructed and tested.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Industrialized Housing: Palm Harbor homes produces at least 3,000 homes with improved air distribution ducts using technology suggested by the training conducted by the EEIH program in factories in Florida, North Carolina, Oregon and Ohio.

Header over description column: **PLANNED**

Year	Milestone Type	Cost	PLANNED
2002	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Industrialized Housing: Web pages, papers and guidelines are developed to transfer the technologies domestically and internationally.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Industrialized Housing: Commercialize DOE-developed factory simulation
	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Residential Buildings Codes: For information on Residential Buildings Codes milestones, see Commercial Buildings Integration milestones, Commercial Buildings Codes.
2003		Estimated Cost (000 $'s): **$3,000** Actual Cost (000 $'s):	Building America: Another 900 homes will bonstructed as direct result of 4 consortia for total of 2000 over 2001-2003 period-as many homes as over 1994-2000 period in HALF the time.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$59,500** Actual Cost (000 $'s):	Building America: 46% average reduction in Building America house space conditioning and water heating energy use.
	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Industrialized Housing: Building Science Consortium and other Building Aerica consortiums use FanRecyclers and other innovations from EEIH project in at least 200 homes in cold climates.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Industrialized Housing: EEIH staff works with at least 4 affiliates of habitat for Humanity and improves the energy efficiency of at least 100 constructed homes throughout the U.S.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Industrialized Housing: New industry partnerships are formed and additional houses constructed and tested.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Industrialized Housing: Palm Harbor homes produces at least 3,000 homes with improved air distribution ducts using technology suggested by the training conducted by the EEIH program in factories in Florida, North Carolina, Oregon and Ohio.
		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Industrialized Housing: Web pages, papers and guidelines are developed to transfer the technologies domestically and internationally.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Industrialized Housing: DOE to make recommendations to HUD on ways to make HUD codes more amenable to incorporation of advanced efficient technologies.

Year	Milestone type	Cost		PLANNED
2003	Market Penetration Milestones	Estimated Cost (000 $'s):	**$0**	Residential Buildings Codes: For information on Residential Buildings Codes milestones, see Commercial Buildings Integration milestones, Commercial Buildings Codes.
		Actual Cost (000 $'s):	**$0**	
2004		Estimated Cost (000 $'s):	**$3,400**	Building America: Another 1100 homes will be constructed as a direct result of work by the four industry teams.
		Actual Cost (000 $'s):		
	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$72,400**	Building America: 48% average reduction in Building America house space conditioning and water heating energy use.
		Actual Cost (000 $'s):		
	Market Penetration Milestones	Estimated Cost (000 $'s):	**$0**	Industrialized Housing: Building Science Consortium and other Building Aerica consortiums use FanRecyclers and other innovations from EEIH project in at least 200 homes in cold climates.
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$0**	Industrialized Housing: EEIH staff works with at least 4 affiliates of habitat for Humanity and improves the energy efficiency of at least 100 constructed homes throughout the U.S.
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$0**	Industrialized Housing: New industry partnerships are formed and additional houses constructed and tested.
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$0**	Industrialized Housing: Palm Harbor homes produces at least 3,000 homes with improved air distribution ducts using technology suggested by the training conducted by the EEIH program in factories in Florida, North Carolina, Oregon and Ohio.
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$0**	Industrialized Housing: Web pages, papers and guidelines are developed to transfer the technologies domestically and internationally.
		Actual Cost (000 $'s):	**$0**	
		Estimated Cost (000 $'s):	**$0**	Residential Buildings Codes: For information on Residential Buildings Codes milestones, see Commercial Buildings Integration milestones, Commercial Buildings Codes.
		Actual Cost (000 $'s):	**$0**	

BTS's State Energy Program (FY99 Appropriation $37 million, FY2000 Request $32 million)

By 2004, the State Energy Program (SEP) will be serving as a major catalyst for State-driven partnerships with End-Use Sectors, other State agencies, the private sector, and communities to help reduce energy use in all sectors. SEP provides the best vehicle for accelerating market acceptance and use of new energy technologies developed by the Department, bridging the gap between research and widespread utilization. The States play a key role in the development of sustainable communities and planning for the future in a way that takes into account energy and environmental concerns. Since States are closer to the industries and individuals that use energy, they are better able to form partnerships and leverage private investment at the local level. Through these activities, in 2004 SEP will achieve approximately 8.4 Tbtu in energy savings and avoid an estimated 1.4 MMTCE in carbon emissions. The program will also create approximately 8,400 jobs that year. Each federal dollar invested in SEP leverage $4 in non-federal funds for energy efficiency programs.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Carbon Equivalent Emissions Displaced (MMTCe)				.10	.20	.29	.38	.47	.55	.90	1.34	1.59
Total Primary Energy Displaced (Trillion Btu)				5.50	10.86	16.12	21.23	25.91	29.72	56.00	78.37	99.06
Energy Costs or Savings (Billions of $'s)				.03	.07	.10	.13	.17	.20	.36	.50	.65

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)		30.25	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00
Research (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Development (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Deployment (%)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Partner Financial Investment (Millions of $'s)	116.00	148.00	148.00	148.00	148.00	148.00	148.00	148.00	148.00	148.00	148.00	148.00
Partner Non-Financial Investment (Millions of $'s)												
Partners (Number)				55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00

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1997 Other Milestones

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$29,000**

State Energy Program: Funded over 550 projects

1998

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$30,250**

State Energy Program: 550 projects completed

PLANNED

1999 Market Penetration Milestones

Estimated Cost (000 $'s): **$37,000**
Actual Cost (000 $'s): **$0**

State Energy Program: Enhanced state-level capability for energy plans/programs which incorporate long-range and immediate issues. States developing strong partnerships with local governments, businesses, and private organizations to implement programs and projects addressing all sectors within the state. Fund approximately 550 projects in coordination with State energy offices.

2000

Estimated Cost (000 $'s): **$37,000**
Actual Cost (000 $'s): **$0**

State Energy Program: Fund approximately 550 projects in coordination with State energy offices.

		PLANNED		
2001	Market Penetration Milestones	Estimated Cost (000 $'s): **$37,000** Actual Cost (000 $'s): **$0**		State Energy Program: Fund approximately 550 projects in coordination with State energy offices.
2002		Estimated Cost (000 $'s): **$37,000** Actual Cost (000 $'s): **$0**		State Energy Program: Fund approximately 550 projects in coordination with State energy offices.
2003		Estimated Cost (000 $'s): **$37,000** Actual Cost (000 $'s): **$0**		State Energy Program: Fund approximately 550 projects in coordination with State energy offices.
2004		Estimated Cost (000 $'s): **$37,000** Actual Cost (000 $'s): **$0**		State Energy Program: Fund approximately 550 projects in coordination with State energy offices.

BTS's Weatherization Assistance Program (FY99 Appropriation $154.1 million, FY2000 Request $129 million)

By 2004, the Weatherization Assistance Program in collaboration with State and local agencies will again be weatherizing over 100,000 homes of low-income families annually, applying cost-effective, advanced diagnostic and energy efficiency technologies to reduce these families' energy bills by an average of greater than 30 percent. This will support a key strategic objective of BTS and EE, while providing the benefits of energy efficiency technologies specifically to families whose energy cost burden is disproportionately high but who can least afford the cost of energy or the investment in efficiency improvements. Over these five years, a total of 457,000 low-income homes will be weatherized beyond the base number of approximately 4.7 million weatherized through FY 1999. This compares to a nationwide need of approximately 29 million income-eligible households. This also represents a concrete contribution to the President's recently announced goal of reducing energy consumption by 30 percent in 15 million existing homes.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Carbon Equivalent Emissions Displaced (MMTCe)				.11	.23	.37	.51	.66	.82	1.53	2.31	2.94
Total Primary Energy Displaced (Trillion Btu)				6.73	13.38	21.67	30.29	39.07	47.63	95.65	140.54	183.95
Energy Costs or Savings (Billions of $'s)				.04	.08	.12	.17	.22	.27	.53	.78	1.05

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)		124.85	161.80	154.10	154.10	182.00	192.00	202.00	212.00	212.00	212.00	212.00
Research (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Development (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Deployment (%)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Partner Financial Investment (Millions of $'s)	197.70	197.70	197.70	197.70	197.70	197.70	197.70	197.70	197.70	197.70	197.70	197.70
Partner Non-Financial Investment (Millions of $'s)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Partners (Number)		806.00	806.00	806.00	806.00	806.00	806.00	806.00	806.00	806.00	806.00	806.00

ACCOMPLISHED

1997 Other Milestones

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$197,700**

Weatherization Assistance: 100,815 homes weatherized with partner financial investment

1998

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$120,800**

Weatherization Assistance: 61,200 homes weatherized with DOE funds

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$198,000**

Weatherization Assistance: 101,900 homes weatherized with non-DOE funds

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$124,000**

Weatherization Assistance: 63,335 homes weatherized with DOE funds

PLANNED

1999 Market Penetration Milestones

Estimated Cost (000 $'s): **$154,075**
Actual Cost (000 $'s): **$0**

Weatherization Assistance: Weatherize additional 180,100 homes (78,200 with direct DOE funds, 101,900 with matching funds).

Year	Milestone	Cost	PLANNED
1999	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$25** Actual Cost (000 $'s):	Weatherization Assistance: Adoption of National Energy Audit (NEAT) and Mobile Home Energy Audit (MHEA) by five more states
2000	Market Penetration Milestones	Estimated Cost (000 $'s): **$154,050** Actual Cost (000 $'s): **$0**	Weatherization Assistance: Weatherize additional 180,100 homes (78,200 direct DOE funds, 101,900 with matching funds)
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$50** Actual Cost (000 $'s): **$0**	Weatherization Assistance: Adoption of NEAT and MHEA by ten more states.
2001	Market Penetration Milestones	Estimated Cost (000 $'s): **$154,000** Actual Cost (000 $'s): **$0**	Weatherization Assistance: Weatherize additional 177,400 homes (77,000 with direct DOE funds, 100,400 with matching funds)
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$100** Actual Cost (000 $'s): **$0**	Weatherization Assistance: Develop Multi-Family audit procedures.
2002	Market Penetration Milestones	Estimated Cost (000 $'s): **$182,000** Actual Cost (000 $'s): **$0**	Weatherization Assistance: Weatherize additional 188,700 homes (89,800 with direct DOE funds, 98,900 with matching funds)
2003		Estimated Cost (000 $'s): **$192,000** Actual Cost (000 $'s): **$0**	Weatherization Assistance: Weatherize additional 190,800 homes (93,400 with direct DOE funds, 97,400 with matching funds)
2004		Estimated Cost (000 $'s): **$202,000** Actual Cost (000 $'s): **$0**	Weatherization Assistance: Weatherize additional 192,900 homes (96,800 with direct DOE funds, 96,100 with matching funds)

DOE's Office of Energy Efficiency & Renewable Energy

GPRA2000 Goal, Resources & Milestones Report

Federal Energy Management Program (FEMP)

FEMP's FEMP (FY99 Appropriation $ million, FY2000 Request $31.868 million)

Reduce energy use in buildings by 20% and 30% per gross square foot by the years 2000 and 2005, respectively, when compared to a 1985 baseline; install in all Federal buildings by 2005 energy and water conservation projects with less than a ten-year payback; significantly increase the use of cost-effective solar and other renewable energy in Federal facilities; reduce Federal industrial energy use by 20% by the year 2000 when compared to a 1990 baseline; and purchase products in the top 25% of their class for energy efficiency, wherever such products are cost-effective and meet agency performance requirements.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Carbon Equivalent Emissions Displaced (MMTons)	.00	.00	.00	.44	.52	.60	.69	.77	.84	1.21	1.21	1.21
Energy Costs or Savings (Billions of $'s)	.00	.00	.00	.16	.19	.21	.27		.29	.40	.39	.38
Total Primary Energy Displaced (Trillion Btu)	.00	.00	.00	24.00	28.66	33.23	37.70	42.09	46.38	66.52	66.52	66.52

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)		19.80	33.87	33.87	33.87	33.87	33.87	33.87	33.87	33.87	33.87	33.87
Research (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Development (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Deployment (%)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Partner Financial Investment (Millions of $'s)			50.00	150.00	250.00	300.00	350.00	350.00	350.00	270.00		
Partner Non-Financial Investment (Millions of $'s)												
Partners (Number)			33.00	100.00	165.00	200.00	233.00	233.00	233.00	180.00		

2000 Other Milestones

PLANNED

Estimated Cost (000 $'s): **$2,000**
Actual Cost (000 $'s): **$0**

FEMP: Develop additional technology-specific Energy Saving Performance Contracts (ESPCs) with a focus on renewable technologies, gas cooling, weatherization, and biomass

Estimated Cost (000 $'s): **$38,868**
Actual Cost (000 $'s): **$0**

FEMP: Reduce site energy intensity (Btu/gross square foot) by 20% relative to 1985 baseline levels in federal facilities

Estimated Cost (000 $'s): **$2,000**
Actual Cost (000 $'s): **$0**

FEMP: Train 360 personnel in all regions.

		PLANNED	
2001	Other Milestones	Estimated Cost (000 $'s): **$500** Actual Cost (000 $'s): **$0**	FEMP: Identify one Federal Agency that will serve as the lead purchaser of high-energy efficiency products.
2002		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	FEMP: By 2002, FEMP will be receiving up to $10 million per year in reimbursable activities. This is an inflow of dollars that's a consequence of the success of the FEMP Service Network.
2003		Estimated Cost (000 $'s): **$135,500** Actual Cost (000 $'s): **$0**	FEMP: Reduce site energy intensity (Btu/gross square foot) by 25% relative to 1985 baseline levels in federal facilities.
2005		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	FEMP: Femp will be receiving up to $20 million per year in reimbursable activities. This is an inflow of dollars that is a consequence of the success of the FEMP Service Network.
		Estimated Cost (000 $'s): **$203,000** Actual Cost (000 $'s): **$0**	FEMP: Reduce site energy intensity (Btu/gross square foot) by 30% relative to 1985 baseline levels in federal facilities.
		Estimated Cost (000 $'s): **$203,000** Actual Cost (000 $'s): **$0**	FEMP: Reduce site energy intensity (Btu/gross square foot) by 30% relative to 1985 baseline levels in federal facilities.

Office of Industrial Technologies (OIT)

OIT's Advanced Materials (CFCC and AIM) (FY99 Appropriation $ million, FY2000 Request $22 million)

By the year 2003, in collaboration with industry, national laboratories and universities, the Continuous Fiber Ceramic Composite (CFCC) Program will develop high performance ceramic materials that will improve productivity, product quality, and energy efficiency in major industrial processes and products. The Program will address the critical need for advanced materials that are lighter, stronger, and more corrosion resistant than metals. The long term objectives are to develop the primary processing methods for reliable and cost effective fabrication of CFCC's and to perform application- specific testing which will meet the needs of a wide range of applications in industry, including power generation, aluminum, steel, chemicals, forest products, glass, metal casting and refining. Industries that use CFCC components in their applications will realize substantial energy, environmental and financial benefits, including higher efficiency, lower maintenance, and decreased operating costs. Program funded research will develop materials with superior high temperature strengths and fatigue resistance, corrosion resistance, and wear resistance. Benefits will accrue from optimization of process operating conditions, reduced down time, and increased useful life times. There are currently six industry teams comprising approximately 45 partners. The teams are led by AlliedSignal Composites, Dow Corning, General Electric, McDermott Technology, and Textron Systems. Together, these teams are developing more than 20 industrial applications for continuous fiber ceramic composite materials. Applications for these materials include gas turbine components, radiant burners, infrared burners, immersion tubes, hot gas filters, furnace fans, chemical filters, and diesel valve guides. The national laboratories and universities are developing supporting technologies (e.g., material design tools, processing methods, standards and codes, and characterization) to enhance the scientific understanding of ceramic composites. The expected outcome of this Program is energy savings of 64.4 trillion BTU's by 2005 and reductions in environmental emissions of CO (.00113 MMTons Displaced), SO2 (.00530 MMTons Displaced), VOCs (.0000647 MMTons Displaced) and NOx (.00764 MMTons Displaced) by 2005. Through energy and environmental efficiencies, the economic benefit to the nation is expected to be $1.42 billion by 2020.

The Advanced Industrial Materials Program (AIM) will continue to support cross-cutting materials development for the Industries of the Future (IOF), with major emphases on high-temperature, corrosion and wear resistant materials and new membranes, filters, and catalytic membranes for more efficient industrial separations. Projects will be selected on the bases of industrial needs, as identified in IOF roadmaps, quantified benefits, and the likelihood that the materials and/or processes will be commercialized or will be transferred to the IOF teams for further development and demonstration. Preference will be given to materials and processes that will benefit more than one of the vision industries.

Research and development will be conducted under the AIM Program by National Laboratory/industry/university teams, as required to ensure success. Opportunities for cooperation with other governmental research organizations will be identified and pursued. The National Science Foundation, the National Institute of Standards and Technology, and various research organizations within the Department of Defense have materials needs similar to those of OIT and have worked with the DOE National Laboratories as a matter of course. Even more opportunities will be sought.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of $'s)									.12	.29	.48	.73
Carbon Equivalent Emissions Displaced (MMTCe)									.62	1.65	2.72	4.11
Total Primary Energy Displaced (Trillion Btu)									38.14	93.45	160.78	237.44

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	14.70	14.47	14.40	14.40	14.50	14.50	6.20	6.30	6.30	6.30	6.30	6.30
Research (%)		.15	.15	.15	.05	.05	.05	.05	.05	.05	.05	.05
Development (%)		.75	.75	.75	.80	.80	.80	.80	.80	.80	.80	.80
Deployment (%)		.10	.10	.10	.15	.15	.15	.15	.15	.15	.15	.15
Partner Financial Investment (Millions of $'s)	2.00	2.00	4.00	4.00	6.00	6.00	3.00	3.00	3.00	3.00	3.00	3.00
Partner Non-Financial Investment (Millions of $'s)												
Partners (Number)			60.00	60.00	60.00	60.00	20.00	22.00	22.00	22.00	22.00	22.00

1997 Other Milestones

	ACCOMPLISHED
Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: CFCC material was selected and fabricated into a full-sized combustion liner set which survived 1,000 hours engine operation, including 1,000 hours in the field at an ARCO installation
Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Completed 528 hours of testing of CFCC non-lubricated diesel engine valve guide in actual diesel cycle engine.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Completed 15,000 thermal cycle tests on radiant burner screens with no failure.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Continued testing of full-scale hot gas filters in pilot scale facilities.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Continued material property characterization and modeling and development of standards and codes.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Long term sample testing completed in application specific environments--4,000 hours in direct-coal burning boiler and over 8,000 hours of long-term sample testing in a crude unit furnace with minimal strength reduction.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Process scale up (120+ parts every 8 weeks) for one CFCC application.

1998

Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Conducting laboratory bench tests on diesel engine valve guides which demonstrates reduced wear from the CFCC.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Fabricated two immersion heater tubes for evaluation in an aluminum casting furnace at an industrial site and successfully tested for over a month at 1,600 degrees F.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Fabricated and performed over 1,500 hours testing of hot gas filters at the Power System Development facility of Southern Company Services in Wilsonville, AL.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Fabricated and performed over 100 hours of testing and 200 flame-off cycles of four different CFCC materials for gas turbine combustion liners and shrouds in a test rig.

1998 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: High Nicalon fiber (CFCC material) was tested for 2,000 hour showing minimum degradation in the field at an ARCO installation

1999

PLANNED

Estimated Cost (000 $'s): Actual Cost (000 $'s):	AIM: Complete development of the uniform droplet process for production of metal powders and test metal filters in industry.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	AIM: Complete development of new FeCrSi alloys, with superior acid resistance for use in the chemical and petroleum industries.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	AIM: Complete development of a new Ni3Al alloy capable of operating at 100o C higher temperature that current alloy.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	AIM: Complete preliminary evaluation of FeAl and NiAl alloys for high temperature fatigue resistance, corrosion resistance, and reduction of coking in refining and chemical applications.

Market Penetration Milestones

Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: First commercial demonstration of CFCC gas turbine components at an industrial site. Demonstration of CFCC material durability and cost for industrial gas turbine combustor.

Technology Characteristic Milestones

Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Continue testing performance of IR Burners for the forest products industry
Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Develop and publish codes and standards for CFCCs for use in design and testing.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Fabricate and test radiant burner screens at industrial partner site.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Fabricate and test hot gas filters for use in the chemical industry.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Fabricate and test radiant burner screens in the glass industry.

Year	Milestone Type	Cost	PLANNED
1999	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Fabricate tip shoe for gas turbines.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Fabricate and test immersion tube burners in melt application.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Fabricate and test turbine tip shroud and combustor liner in test rig.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Field test demonstration of CFCC gas turbine components.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: First commercial demonstration of CFCC industrial gas turbine combustor liners.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Select protective fiber coating to optimize performance.
2000	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	AIM: Complete development of the infrared heating process for heat treating steels and other metals.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	AIM: Complete development of aluminum/alumina composites by molten metal infiltration and continue work on other alloy systems, with emphasis on intermetallic alloy composites.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	AIM: Expand nickel aluminide applications in the steel, metal casting, chemical, forest products, and refining industries.
	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Commercialization of CFCC immersion tube burners.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Demonstration of hot gas filters in the chemical industry.

Year	Milestone Type	Cost	PLANNED
2000	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Field test of IR burners at an industrial site.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Successful component tests in at least three of the Industries of the Future.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Successful component tests in at least three of the Industries of the Future.
2001	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	AIM: Complete evaluation of refractory materials for the glass, forest products, steel, and aluminum industries.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	AIM: Complete materials needs and opportunity assessments for all the IOF industries.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	AIM: Complete project on improved materials for kraft recovery boilers.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	AIM: Initiate work on new materials for pulp digesters.
2003	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Commercialization of CFCC IR burners.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Commercialization of CFCC hot gas filters.
	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Complete program with turbine liners, shrouds, rim seals, and tip shoes successfully developed and demonstrated.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Complete program with at least seven applications successfully developed and demonstrated.

2003	Other Milestones		**PLANNED**
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Complete the CFCC program with at least seven applications successfully developed and demonstrated.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Complete the CFCC program with at least seven successfully developed and demonstrated.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Complete the CFCC program with at least seven applications successfully developed and demonstrated.
2005	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	CFCC: Commercialization of combustor liners.

OIT's Aluminum Vision (FY99 Appropriation $ million, FY2000 Request $8.178 million)

In collaboration with the U.S. aluminum industry, academia, and other federal and state agencies, the Office of Industrial Technologies' Aluminum Partnership will fund R&D to address the research needs of the Aluminum industry as identified in the Aluminum Industry Technology Roadmap of May, 1997. The Aluminum Partnership supports and enhances the global-competitiveness and ecological sustainability of the U.S. aluminum industry through strategic, leveraged investments in technologies that save energy, improve productivity, and reduce waste. By 2005, the Aluminum Partnership will save 17.1 trillion Btus of energy annually.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Total Primary Energy Displaced (Trillion Btu)		.00	.00	.00	.00	.00	.00		20.50	49.00	108.00	187.00
Energy Costs or Savings (Billions of $'s)		.00	.00	.00	.00	.00	.00	.00	.08	.20	.41	.60
Carbon Equivalent Emissions Displaced (MMTons)		.00	.00	.00	.00	.00	.00		.41	1.04	2.37	4.44

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	5.59	7.34	8.18	8.18	9.70	9.70	10.50	12.00	12.00	12.00	12.00	12.00
Research (%)		.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50
Development (%)		.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50
Deployment (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Partner Financial Investment (Millions of $'s)	.80	1.30	1.40	1.40	1.60	1.60	1.80	2.00	2.00	2.00	2.00	2.00
Partner Non-Financial Investment (Millions of $'s)	.80	1.30	1.40	1.40	1.60	1.60	1.80	2.00	2.00	2.00	2.00	2.00
Partners (Number)	20.00	30.00	35.00	35.00	40.00	40.00	40.00	45.00	45.00	45.00	45.00	45.00

1997 Other Milestones

	ACCOMPLISHED
Estimated Cost (000 $'s): Actual Cost (000 $'s):	Aluminum Vision Program: Awarded 11 Innovative Concepts projects.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	Aluminum Vision Program: Awarded 4 new cost shared projects to support implementation of Roadmap.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	Aluminum Vision Program: Completed Aluminum Industry Roadmap and Issued Solicitation.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	Aluminum Vision Program: Developed Implementation Plan.
Estimated Cost (000 $'s): Actual Cost (000 $'s):	Aluminum Vision Program: Signed Aluminum R&D Partnerships Compact with the Aluminum Industry.

Year	Milestone Type	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	Description
				ACCOMPLISHED
1998	Other Milestones			Aluminum Vision Program: Awarded 5 new cost-shared projects to support implementation of the Aluminum Industry Roadmaps.
		$3,550	$3,550	Aluminum Vision Program: Completed second pilot scale test of cermet inert anode.
				Aluminum Vision Program: Completed Inert Anode Roadmap.
	Technology Characteristic Milestones	$870	$870	Aluminum Vision Program: Completed pilot scale testing of vertical flotation melter.
		$4,050	$4,050	Aluminum Vision Program: Designed pilot scale electrodialysis unit for saltcake recycling.
		$6,140	$6,140	Aluminum Vision Program: Developed computer models of spray-forming process and designed an Advanced Development Unit.
				PLANNED
1999		$600		Primary Alumimum Sector: Complete pilot scale vitrification tests to produce glass fiber from spent potliners.
		$2,550		Primary Alumimum Sector: Conduct 1st pilot cell test for wettable cathode materials.
		$1,400		Primary Alumimum Sector: Construct pilot scale electrodialysis unit for saltcake recycling.
		$2,600		Primary Alumimum Sector: Fabrication and evaluation of advanced anode materials.
		$600		Semi-fabricated Aluminum Sector: Complete full scale vertical floatation melter design and host site facility modification.

		PLANNED		
1999	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$290** Actual Cost (000 $'s):		Semi-fabricated Aluminum Sector: Completion of commercial demonstration of filter and sensor technology for the removal of salts from aluminum melt.
		Estimated Cost (000 $'s): **$600** Actual Cost (000 $'s):		Semi-fabricated Aluminum Sector: Construct an Advanced Development Unit (ADU) for lab/pilot scale spray forming of aluminum.
		Estimated Cost (000 $'s): **$760** Actual Cost (000 $'s):		Semi-fabricated Aluminum Sector: Demonstrate commercial scale high-efficiency, low Nox combustion for aluminum scrap remelting.
		Estimated Cost (000 $'s): **$280** Actual Cost (000 $'s):		Semi-fabricated Aluminum Sector: Lab and plant trial test of an In-line Grain Refiner will be conducted on a 30-lb. Furnace.
2000		Estimated Cost (000 $'s): **$970** Actual Cost (000 $'s):		Primary Alumimum Sector: Complete pilot scale testing of aluminum waste by-product processing.
		Estimated Cost (000 $'s): **$600** Actual Cost (000 $'s):		Primary Alumimum Sector: Complete pilot scale electrodialysis test for saltcake recycling.
		Estimated Cost (000 $'s): **$570** Actual Cost (000 $'s):		Primary Alumimum Sector: Perform 2nd pilot cell test and first full size test for wettable cathode.
		Estimated Cost (000 $'s): **$960** Actual Cost (000 $'s):		Primary Alumimum Sector: Pilot scale tests of advanced anode materials.
		Estimated Cost (000 $'s): **$650** Actual Cost (000 $'s):		Primary Alumimum Sector: Process parameters established for additives to potliner materials for improving performance and recyclability.
	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Semi-fabricated Aluminum Sector: Market introduction of high efficiency, low Nox combustion for aluminum scrap remelting.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):		Semi-fabricated Aluminum Sector: Market introduction of filter and sensor technology for the removal of the salts from aluminum melt.

		PLANNED		
2000	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$600**	Semi-fabricated Aluminum Sector: Begin commercial scale demonstration of vertical floatation melter.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$770**	Semi-fabricated Aluminum Sector: Conduct spray forming test with ADU and produce sheet samples for commercial evaluation.
2001		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$460**	Primary Alumimum Sector: Complete engineering aspects of aluminum waste by-product processing.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):		Primary Alumimum Sector: Conduct second full size test of wettable cathode; Down select for optimum anode/cathode materials and design.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$300**	Primary Alumimum Sector: Demonstrate desired characteristics of advanced potliner materials under aluminum production conditions.
	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Semi-fabricated Aluminum Sector: Introduction of new grain refining technologies into existing cast house facilities.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Semi-fabricated Aluminum Sector: Compete commercial scale demonstration of vertical floatation melter.
2002	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Primary Alumimum Sector: Market introduction of technology for products from spent potliners.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):		Primary Alumimum Sector: Market introduction of saltcake recycling using elecrodialysis.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$290**	Primary Alumimum Sector: Commercial demonstration of advanced potliner materials.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):		Primary Alumimum Sector: Complete design of commercial retrofit package for inert anode.

Year	Milestone Type	PLANNED		
2002	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$240** Actual Cost (000 $'s):		Primary Alumimum Sector: Complete technology marketing and commercialization plan for aluminum waste processing.
	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Semi-fabricated Aluminum Sector: Market introduction of vertical floatation melter.
2003		Estimated Cost (000 $'s): Actual Cost (000 $'s):		Primary Alumimum Sector: Market introduction of advanced potliner chemistry.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Primary Alumimum Sector: Evaluation of financial feasibility of anode retrofit package for inert anode.
2004	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Primary Alumimum Sector: Market introduction of technology for processing aluminum waste materials to produce useable products.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Primary Alumimum Sector: Construction and installation of anode package into commercial scale cell.
	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Semi-fabricated Aluminum Sector: Market introduction of Spray Forming Technology.
2005		Estimated Cost (000 $'s): Actual Cost (000 $'s):		Primary Alumimum Sector: Market introduction of wettable cathod technology.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Primary Alumimum Sector: Commercial scale demonstration of inert anode

OIT's Chemicals Vision (FY99 Appropriation $ million, FY2000 Request $12.492 million)

The Industries of the Future Chemical Vision will continue to address R&D activities within the "Technology Vision 2020: The U.S. Chemical Industry" structure with a focus on new chemical science and engineering: New chemical science and engineering is the fundamental driver of advances within the chemical industry. Chemical Science includes chemical synthesis, bioprocesses and biotechnology, material technology, and the enabling technologies of process science and engineering, chemical measurement and computational technologies. The program has identified areas with energy savings potential. These include catalysis, bioprocesses, separations, computer technology and chemical industry materials of construction.

Research and development awards will be made on a competitive basis in continuation with procedures started in fiscal year 1998. The Department issued a solicitation based on research needs identified in the Chemical Industry's Vision 2020 and resulting roadmapping activities. Research proposals were requested in the topical areas of bioprocesses, catalysis, and separations that would result in energy savings. Also internal Department of Energy research was competed within the Department's National Laboratory structure. Similar competitive processes will be followed in fiscal 2000 and beyond in areas with significant energy savings reduction potential that have been identified in the chemical industry roadmaps.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Total Primary Energy Displaced (Trillion Btu)									56.86	151.41	367.33	830.49
Energy Costs or Savings (Billions of $'s)									.13	.34	.53	1.02
Carbon Equivalent Emissions Displaced (MMTCe)									.75	1.87	4.13	7.58

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	10.10	11.61	12.05	12.50	13.80	15.20	16.70	18.40	18.40	18.40	18.40	18.40
Research (%)	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20
Development (%)	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80
Deployment (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Partner Financial Investment (Millions of $'s)	8.10	9.30		10.00	12.00	13.00	15.00	16.00	16.00	16.00	16.00	16.00
Partner Non-Financial Investment (Millions of $'s)	1.90	2.20	4.00	6.00	7.00	7.00	8.00	9.00	9.00	9.00	9.00	9.00
Partners (Number)	14.00	15.00	30.00	42.00	46.00	48.00	50.00	55.00	55.00	55.00	55.00	55.00

1996 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Chemicals Vision Program: Held a compact signing with chemical industry CEOs.

1997

Estimated Cost (000 $'s): **$5**
Actual Cost (000 $'s): **$5**

Chemicals Vision Program: Completed Computational Fluid Dynamics Technology Roadmap.

Estimated Cost (000 $'s): **$1,650**
Actual Cost (000 $'s): **$1,650**

Chemicals Vision Program: Demonstration plant for ASR recovered 2000 lbs. of polyurethane foam. Appliance Recycling Centers of America agreed to operate plastics separation pilot plant.

1998

Estimated Cost (000 $'s): **$500**
Actual Cost (000 $'s): **$500**

Chemicals Vision Program: Assessed alternative methods to convert additional sugars (other raw materials) than initially analyzed to improve the energy efficiency of the biobased products.

Year	Milestone Type		Cost	Description
				ACCOMPLISHED
1998	Other Milestones	Estimated Cost (000 $'s):	**$600**	Chemicals Vision Program: Completed testing of ethylene diamine/water separation.
		Actual Cost (000 $'s):	**$600**	
		Estimated Cost (000 $'s):	**$500**	Chemicals Vision Program: Determined a method to double fermentation productivity to increase product recovery and to increase efficiency performance of the bioprocesses.
		Actual Cost (000 $'s):	**$500**	
		Estimated Cost (000 $'s):	**$150**	Chemicals Vision Program: Five technology roadmap workshops conducted.
		Actual Cost (000 $'s):	**$150**	
		Estimated Cost (000 $'s):	**$600**	Chemicals Vision Program: Modeled xylene mixture molecular sieve permeation
		Actual Cost (000 $'s):	**$600**	
		Estimated Cost (000 $'s):	**$4,200**	Chemicals Vision Program: Seventeen new products in place to support Vision 2020.
		Actual Cost (000 $'s):	**$4,200**	
		Estimated Cost (000 $'s):	**$2,300**	Chemicals Vision Program: Started pilot plant froth flotation separation of post-consumer plastics
		Actual Cost (000 $'s):	**$2,300**	
		Estimated Cost (000 $'s):	**$700**	Chemicals Vision Program: Started tests with mixed sugars from lignocellulosic hydrolysates for the production of succinic acid.
		Actual Cost (000 $'s):	**$700**	
				PLANNED
1999	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$500**	Bioprocesses: Determine catalytic needs to minimize deactivation and reagent/solvent recover
		Actual Cost (000 $'s):		
		Estimated Cost (000 $'s):	**$500**	Bioprocesses: Optimize fermentation of mixed sugars to double generation of succinic acid per gram of feedstock
		Actual Cost (000 $'s):		
	Other Milestones	Estimated Cost (000 $'s):		Chemicals Vision Program: Three additional roadmaps published.
		Actual Cost (000 $'s):		
	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$200**	Separations: Characterize composite films for xylene type mixtures
		Actual Cost (000 $'s):		

Year	Milestone type	PLANNED		
1999	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$1,200**	Separations: Complete pilot plant froth flotation separation of post-consumer plastics including automotive plastics.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$200**	Separations: Synthesize leak-free supported inorganic composite silica/molecular sieve films for xylene type mixtures
2000	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Bioprocesses: Process scale-up completed in pilot plant
	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$5,000**	Chemicals Vision Program: Five new projects in place to support Vision 2020.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$1,200**	Separations: Demonstrate separation of froth flotation process at commercial scale assuming private sector financing.
2001	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Bioprocesses: Complete plant and engineering design.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$100**	Separations: Optimize molecular sieve membranes on porous supports; characterize zeolite film.
2002	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Bioprocesses: Ground breaking of production plant.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):		Chemicals Vision Program: Demonstrate process for recovery of chemicals from thermoset plastics.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$1,400**	Computational Technologies: Models of 'dense' gas-solid flow will be available and verified with a pilot plant set-up. These models will have the capability to be used on a supercomputer or a number of small computers linked together.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$300**	Separations: Scale up molecular sieve membrane synthesis: (1) Evaluate long-term stability and performance of membranes; and (2) Design pilot plant module.

		PLANNED	
2004	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Bioprocesses: Produce first production quantities of specialty chemicals/derivatives.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Computational Technologies: Computational fluid dynamics (CFD) technology is commercialized by software technology companies.
2005		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Computational Technologies: First commercial application of CFD technology, which will most likely be in the petroleum cracking industry. With the new technology, industry will have the capability to do the following: (1) Decide if a catalytic cracking unit is in compliance with particulate emission standards (due to the complexity of the process, this cannot be measured directly); (2) Enhance the yield of a barrel of oil to gasoline or chemical by 10-20 percent; and (3) Design new cracking processes that were beyond the scope of the old capabilities.
2020		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Computational Technologies: CFD technology is used by half of the chemical industry, saving 1 percent of the energy used by the chemical industry in 1996 (6 quadrillion BTU), or 10 trillion Btu. Corresponding waste savings are 4.5 million metric tons of waste not generated each year.

OIT's Forest & Paper Products Vision (FY99 Appropriation $ million, FY2000 Request $14.076 million)

In collaboration with the forest products industry as represented by the American Forest and Paper Association, the Office of Industrial Technologies will undertake $12 million of near, mid and long term research and development activities. These activities will support the research outlined in "Agenda 2020: A Technology Vision and Research Agenda for America's Forest, Wood and Paper Industry" which furthers the national goals of energy and resource efficiency, environmental compatibility, and improved global competitiveness. Over 400 large, medium and small companies are participating along with other government agencies, national laboratories, universities and states. Specific goals of this strategy include increasing fiber growth rates by 4 times, reducing water effluent by 20,000 gallons per ton, becoming energy self sufficient, reducing capital requirements per unit of product and recovering 50% of the fiber used.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of $'s)									.00	.74	.00	5.66
Carbon Equivalent Emissions Displaced (MMTCe)									.00	4.56	.00	37.28
Total Primary Energy Displaced (Trillion Btu)									.00	194.00	.00	1508.00

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	11.14	12.04	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10
Research (%)		.50	.50	.40	.40	.30	.30	.30	.20	.20	.20	.20
Development (%)		.50	.50	.60	.60	.70	.70	.70	.80	.80	.80	.80
Deployment (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Partner Financial Investment (Millions of $'s)	1.35	.95	1.80	1.70	2.00	2.20	2.30	2.40	2.50	2.50	2.50	2.50
Partner Non-Financial Investment (Millions of $'s)	2.03	3.79	2.66	2.53	2.97	3.30	3.40	3.60	3.70	3.70	3.70	3.70
Partners (Number)		60.00	60.00	65.00	65.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00

1996 Other Milestones

ACCOMPLISHED

Year	Cost	Accomplishment
1996	Estimated Cost (000 $'s): **$12,790** Actual Cost (000 $'s): **$12,790**	Forest & Paper Products Vision Program: 1) Improved recycled office paper contaminant removal technology; 2) Improved black liquor steam reforming technology.
	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Forest & Paper Products Vision Program: Renewed partnership compact between DOE and the American Forest and Paper Association.
	Estimated Cost (000 $'s): **$4,300** Actual Cost (000 $'s): **$4,590**	Forest & Paper Products Vision Program: Research projects were started in four of the six technology areas identified in response to the research pathways defined by the industry task force groups.
	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Forest & Paper Products Vision Program: Researched pathways developed for each of the 6 technology areas identified in Agenda 2020.
1997	Estimated Cost (000 $'s): **$1,200** Actual Cost (000 $'s): **$1,200**	Forest & Paper Products Vision Program: Black Clawson Company commercialized two energy efficient contaminant removal technologies for use in paper recycling.

Year	Milestone Type	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	Description
		ACCOMPLISHED		
1997	Other Milestones	$1,720	$1,720	Forest & Paper Products Vision Program: Improved recovery of chemicals from black liquor using electrolysis. Demonstrated in a mill environment, however, not commercialized.
		$6,820	$7,660	Forest & Paper Products Vision Program: Research projects started in all 6 technology areas in response to the research pathways defined by the industry task groups.
1998		$3,780	$3,780	Forest & Paper Products Vision Program: Agenda 2020 task groups identified 4 projects as near term technical successes.
		$0	$0	Forest & Paper Products Vision Program: Research pathways will be published by the Forest Products industry. A draft implementation plan is being reviewed for publication.
	Technology Characteristic Milestones	$950	$950	Forest & Paper Products Vision Program: Refiner Disc Gap & Wear Sensor was successfully demonstrated on both the pilot scale and mill scale. The sensor has been commercialized.
		$930	$930	Forest & Paper Products Vision Program: Three successful Black Liquor Viscometer mill trials.
		$3,280	$3,280	Forest & Paper Products Vision Program: Ultrasonic Senor pilot trial.
		DELAYED		
	Other Milestones	$0	$0	Forest & Paper Products Vision Program: Partnership with American Forest & Paper Association will be renewed. The partnership has not been renewed due to changes within the management of DOE.
		PLANNED		
		$1,200		Forest & Paper Products Vision Program: Mill demonstration of feedstock to product characterization tools sensor.
		$5,290		Forest & Paper Products Vision Program: Pilot scale demonstration of impulse drying technology.
1999				Forest & Paper Products Vision Program: Agenda 2020 task groups identify 5 projects as near term successes.

Year	Milestone Type		Cost	PLANNED
1999	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	$5,000	Forest & Paper Products Vision Program: Complete 26 projects in support of Agenda 2020.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	$3,000	Forest & Paper Products Vision Program: Initiate 20 new projects in support of Agenda 2020.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	$1,200	Forest & Paper Products Vision Program: Development of feedstock to produce characterization tools commercial partner acquired.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	$710	Forest & Paper Products Vision Program: Mill validation of VOC control model in a Kraft mill and demonstration of membrane separation technology.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	$3,280	Forest & Paper Products Vision Program: Ultrasonic Sensor successful mill trial required.
2000	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Forest & Paper Products Vision Program: Agenda 2020 task groups identify 5 projects as near term successes.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	$5,000	Forest & Paper Products Vision Program: Complete 9 projects in support of Agenda 2020.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	$3,000	Forest & Paper Products Vision Program: Initiate 20 new projects in support of Agenda 2020.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	$700	Forest & Paper Products Vision Program: Commercial use of market aided selection methods for selection of genotypes for cloning
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	$510	Forest & Paper Products Vision Program: Mill use of high efficiency, chlorine dioxide delignification procedures.
2001	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Forest & Paper Products Vision Program: Agenda 2020 task groups identify 5 projects as near term successes.

Year	Milestone Type		Cost	PLANNED
2001	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$5,000**	Forest & Paper Products Vision Program: Complete 20 projects in support of Agenda 2020.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$3,000**	Forest & Paper Products Vision Program: Initiate 20 new projects in support of Agenda 2020.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):		Forest & Paper Products Vision Program: Renew Partnership with the American Forest and paper Association.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$1,200**	Forest & Paper Products Vision Program: Commercialize feedstock to product characterization sensor.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$1,190**	Forest & Paper Products Vision Program: Mill demonstration of VOC reduction technology.
2002	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Forest & Paper Products Vision Program: Agenda 2020 task groups identify 5 projects as near term successes.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$5,000**	Forest & Paper Products Vision Program: Complete 20 projects in support of Agenda 2020.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$3,000**	Forest & Paper Products Vision Program: Initiate 20 new projects in support of Agenda 2020.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$2,500**	Forest & Paper Products Vision Program: Mill demonstration of polyoxometalate bleaching technology.
2003	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Forest & Paper Products Vision Program: Agenda 2020 task groups identify 5 projects as near term successes.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):		Forest & Paper Products Vision Program: Agenda 2020 vision will be updated by the forest products industry.

			PLANNED
2003	Other Milestones	Estimated Cost (000 $'s): **$5,000** Actual Cost (000 $'s):	Forest & Paper Products Vision Program: Complete 20 projects in support of Agenda 2020.
		Estimated Cost (000 $'s): **$3,000** Actual Cost (000 $'s):	Forest & Paper Products Vision Program: Initiate 20 new projects in support of Agenda 2020.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$280** Actual Cost (000 $'s):	Forest & Paper Products Vision Program: Chemical/physical and biofiltration technologies for air emission reduction successful mill demonstration.
		Estimated Cost (000 $'s): **$2,150** Actual Cost (000 $'s):	Forest & Paper Products Vision Program: Mill demonstration of contactless sensor to measure paper properties on-line
		Estimated Cost (000 $'s): **$1,260** Actual Cost (000 $'s):	Forest & Paper Products Vision Program: Successful pilot demonstration required for low lignin content pulp, digester control technology.
2004	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Forest & Paper Products Vision Program: Agenda 2020 task groups identify 5 projects as near term successes.
		Estimated Cost (000 $'s): **$5,000** Actual Cost (000 $'s):	Forest & Paper Products Vision Program: Complete 20 projects in support of Agenda 2020.
		Estimated Cost (000 $'s): **$3,000** Actual Cost (000 $'s):	Forest & Paper Products Vision Program: Initiate 20 new projects in support of Agenda 2020.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Forest & Paper Products Vision Program: Renew Partnership with the American Forest and paper Association.

OIT's Glass Vision (FY99 Appropriation $ million, FY2000 Request $4.83 million)

The Office of Industrial Technologies Glass Vision program, in collaboration with the glass industry, will support R&D to address the goals and critical research needs identified in the Glass Industry Roadmap. These include (but are not limited to) improved melting, refining, fabrication and forming processes; advanced sensors and measurement techniques; computer simulation and integrated control of glass processes; longer-lived refractory materials; improved emissions controls; advances in recycling and waste management; and new innovative glass products. By the year 2005, technologies supported through the Glass Vision program could displace 22 trillion Btu of energy (and $76 billion in energy costs), with an associated carbon reduction of 0.38 MMTCE.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Total Primary Energy Displaced (Trillion Btu)									23.00	40.00	56.00	73.00
Energy Costs or Savings (Billions of $'s)									.08	.15	.21	.31
Carbon Equivalent Emissions Displaced (MMTCe)									.40	.70	1.02	1.41

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	3.00	4.61	5.00	5.50	6.00	6.50	7.00	7.50	7.50	7.50	7.50	7.50
Research (%)		.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20
Development (%)		.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80
Deployment (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Partner Financial Investment (Millions of $'s)	2.40	2.40	3.50	3.80	4.00	4.20	4.40	4.60	4.60	4.60	4.60	4.60
Partner Non-Financial Investment (Millions of $'s)	.60	.60	1.20	1.20	1.40	1.60	1.80	2.00	2.00	2.00	2.00	2.00
Partners (Number)		37.00	37.00	40.00	42.00	46.00	48.00	50.00	50.00	50.00	50.00	50.00

1996 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s): **$600**
Actual Cost (000 $'s): **$600**

Glass Vision Program: Deployed Oxygen Enriched Air Staging (OEAS) Project. OEAS technology has been retrofitted to several endport furnaces and has achieved 50-70% NOx reduction.

1997

Estimated Cost (000 $'s): **$25**
Actual Cost (000 $'s): **$25**

Glass Vision Program: Held Glass Technology Roadmap Workshop; developed needed baseline data for final Glass Technology Roadmap.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Glass Vision Program: Licensed OEAS technology to Combustion Tec, Inc..

DELAYED

1998

Estimated Cost (000 $'s): **$40**
Actual Cost (000 $'s): **$40**

Glass Vision Program: Publish Glass Technology Roadmap. Expected in FY99.

PLANNED

1999 Market Penetration Milestones

Estimated Cost (000 $'s): **$1,000**
Actual Cost (000 $'s):

Glass Vision Program: Develop a three-dimensional combustion space model to optimize furnace operation (new and existing).

Year	Milestone type	Cost		PLANNED
1999	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$1,300**	Glass Vision Program: Develop integrated batch and cullet preheat system for glass furnaces.
2000		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$1,100**	Glass Vision Program: Develop improved systems for control of auto glass properties and quality.
	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$50**	Glass Vision Program: Develop Roadmap implementation plan.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$1,000**	Glass Vision Program: Develop and validate three-dimensional combustion space model based on actual furnace data.
2001	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$700**	Glass Vision Program: Develop new optically transparent coatings for float glass.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$1,200**	Glass Vision Program: Develop new structural components and advanced coatings to increase furnace efficiency and refractory life.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$1,400**	Glass Vision Program: Develop integrated system for auto glass process control: optical sensors; numerical methods for modeling radiation in optically thin materials; integration of forming and optical stress measurements.

OIT's IAC (FY99 Appropriation $8.3 million, FY2000 Request $8.3 million)

By the end of 2004, in collaboration with 30 universities, and a total of more than 2,850 graduated engineering students, over 12,850 industrial audits/assessments will have been completed since 1981. The Industrial Assessment Center Program will assist 750 small- and medium-sized manufacturers per year in identifying opportunities to streamline their operations and implement at least 50% of the 5,400 energy efficiency, waste minimization, pollution prevention, and productivity enhancing recommendations. By investing an average of $28,200, each company assisted will then save an average of $19,600 in energy costs and $39,400 in non-energy costs per year. By 2004, the 5,250 sites visited from 1998 - 2004 (inclusive), along with 3,150 affiliated sites (intracompany replication), and the 1,430 sites where program "alumni" work (half the graduated students continue to work in the EE industry) will collectively enjoy a savings of 76.2 Trillion Btus of energy per year.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of $'s)	.21	.26	.28	.30	.32	.33	.34		.35	.37	.38	.38
Total Primary Energy Displaced (Trillion Btu)	49.40	62.00	67.00	71.00	76.00	79.00	82.00		86.00	93.00	97.00	99.00
Carbon Equivalent Emissions Displaced (MMTCe)	1.05	1.32	1.43	1.51	1.62	1.68	1.74		1.83	1.98	2.06	2.11

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	7.20	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30
Research (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Development (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Deployment (%)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Partner Financial Investment (Millions of $'s)	29.90	34.47	34.47	34.47	34.47	34.47	34.47	34.47				
Partner Non-Financial Investment (Millions of $'s)	.75	.75	.75	.75	.75	.75	.75	.75				
Partners (Number)	14438.80	15778.80	17118.80	18458.80	19798.80	21138.80	22478.80	23818.80				

ACCOMPLISHED

1996 Other Milestones

Estimated Cost (000 $'s): **$6,380**
Actual Cost (000 $'s): **$6,380**

IAC Program: 870 assessments done.

1997

Estimated Cost (000 $'s): **$6,400**
Actual Cost (000 $'s): **$6,320**

IAC Program: 720 assessments done.

1998

Estimated Cost (000 $'s): **$8,300**
Actual Cost (000 $'s): **$6,320**

IAC Program: 750 assessments and 40 extended assessments.

Estimated Cost (000 $'s):
Actual Cost (000 $'s): **$30**

IAC Program: Initiated a program critical review process

PLANNED

1999 Market Penetration Milestones

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

IAC Program: New eligibility requirements will be considered by the Critical Review Team which may lead to an expansion of possible program target audience, size of the firm requesting the assessment, distance from the IACs, and eligible SICs are some of the criteria that may change.

1999	Other Milestones	**PLANNED**	
		Estimated Cost (000 $'s): **$50** Actual Cost (000 $'s):	IAC Program: IAC Critical Review final report due.
2000		Estimated Cost (000 $'s): Actual Cost (000 $'s):	IAC Program: Program Critical Review implementation begins.
2001		Estimated Cost (000 $'s): Actual Cost (000 $'s):	IAC Program: Exact milestones will be determined by the Critical Review Team.
2002		Estimated Cost (000 $'s): Actual Cost (000 $'s):	IAC Program: More emphasis on IOF plants. Integrated delivery with: IOF, Motor Challenge, Steam Challenge and Compressed Air Challenge.
2003		Estimated Cost (000 $'s): Actual Cost (000 $'s):	IAC Program: More emphasis on IOF plants. Integrated delivery with: IOF, Motor Challenge, Steam Challenge and Compressed Air Challenge.
2004		Estimated Cost (000 $'s): Actual Cost (000 $'s):	IAC Program: More emphasis on IOF plants. Integrated delivery with: IOF, Motor Challenge, Steam Challenge and Compressed Air Challenge.

OIT's Integrated Delivery Program (FY99 Appropriation $9.6 million, FY2000 Request $11 million)

Integrated Delivery includes:

Motor Challenge
Steam Challenge
Compressed Air Challenge
Combined Heat and Power Challenge
Showcase Demonstrations

In FY 2000, the Integrated Delivery Program will be introduced in order to provide a means of bringing the full range of OIT tools, technical assistance and technology to thousands of plant sites. The goal of the Challenge Programs is to increase the market penetration of energy efficient technologies and practices. As such, the Program must influence a sufficient number of industrial end-users to adopt and commit to a comprehensive array of system management practices so that energy efficiency principles are institutionalized within U.S. industry. The Challenge programs are encouraging a systems approach to how all types of industrial processes are designed, modified, and improved. They plan to do this by delivering unbiased and reliable information to U.S. industries, so that plant personnel, technical and financial, can make the most informed decisions. Accordingly, developing and disseminating a variety of information, design-decision tools, analytic software, best practice Showcase Demonstrations, and case studies to thousands of end-users is an important strategy of the Challenge Programs.

Working in partnership with industry associations, suppliers, consultants, engineering firms, and national laboratories, by FY 2005, the Challenge programs will save over 75 trillion btus of energy, over $250 million in energy costs, and over 1.4 MMTCE. The core of the Integrated Delivery approach is the development of one-on-one, on-going partnerships between ALL of OIT and plant site personnel who have agreed to open their plants so that energy efficient technologies and practices may be replicated across entire industries.

Because the national benefits of the CHP component of the Challenge Program are assumed to enhance the benefits of the Cogeneration planning unit, and are included under Cogeneration, the $1 million annual funding for CHP is shown also under Cogeneration, starting in 2000. This convention is intended to simplify benefit/cost comparisons. Other resource metrics and performance milestones for CHP are included with the Integrated Delivery planning unit as part of the Challenge Programs.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Total Primary Energy Displaced (Trillion Btu)			17.34	27.13	36.92	46.71	56.51	66.30	76.09	157.82	259.19	331.27
Energy Costs or Savings (Billions of $'s)			.08	.11	.15	.18	.22	.25	.29	.60	.96	1.25
Carbon Equivalent Emissions Displaced (MMTCe)			.41	.58	.75	.91	1.08	1.24	1.41	3.05	5.03	6.61

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	5.14	6.23	9.60	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
Research (%)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Development (%)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Deployment (%)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Partner Financial Investment (Millions of $'s)	9.45	11.45	17.65	20.22	20.22	20.22	20.22	20.22	20.22	42.89	62.58	62.72
Partner Non-Financial Investment (Millions of $'s)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Partners (Number)												

1997	Other Milestones	Cost	ACCOMPLISHED
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Integrated Delivery: 151 Allied Partners enrolled
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Integrated Delivery: 2,170 total program partners.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Integrated Delivery: Worked extensively with TAPPI to gain strong relationship with Pulp and Paper industry.
		Estimated Cost (000 $'s): Actual Cost (000 $'s): **$2**	Showcase Demonstrations: 10 Showcase Demonstrations completed with 16.2 GWh/yr documented energy savings.
1998		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Combined Heat and Power Challenge: Combined Heat and Power (DOE and Industry) teams formed and stakeholder meetings held.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Compressed Air Challenge: Compressed Air Challenge - 9 industry partners and DOE pool $300,000 in resources to formulate the Compressed Air program. Compressed Air Challenge announced.
		Estimated Cost (000 $'s): Actual Cost (000 $'s): **$1**	Integrated Delivery: 1,113 Clearinghouse technical assistance cases.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Integrated Delivery: 203 Allied Partners enrolled
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Integrated Delivery: Initiated partnership with Bethlehem Steel's Burns Harbor Plant.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Mining Vision: 2,928 total program partners.
		Estimated Cost (000 $'s): Actual Cost (000 $'s): **$2**	Showcase Demonstrations: 14 Showcase Demonstrations completed with 16.2 GWh/yr documented energy savings

Year	Milestones	Cost	Description
			ACCOMPLISHED
1998	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Steam Challenge: Steam Challenge Kick-off, in conjunction with the Steel and Forest Products teams, the first two Showcase Demonstration stores are completed.
			PLANNED
1999	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Combined Heat and Power Challenge: Initiate Combined Heat and Power Challenge Program for improved deployment of CHP systems.
2000		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Integrated Delivery: 6 IOF Plant sites participate with OIT in Integrated Delivery effort designed to produce plants that are showcases for energy efficiency and clean production.
2001		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Integrated Delivery: Motor, Steam, Compressed Air and Combined Heat and Power Challenge Programs contact/provide technical information to 3,000 end-users in the highest (top 3.5 percent) energy consumption group. Form among 3,000 established partnerships with 100 IOF Plant Sites to provide integrated delivery tools and technical assistance.
2002		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Compressed Air Challenge: Compressed Air Challenge will have a fully operational professional development program to train plant operating personnel on compressed air system best practices, and a certification program for individuals who apply these best practices.
2003		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Steam Challenge: Steam Challenge will support 25 case studies on steam system best practices and will have developed software tools and information in partnership with trade and technical associations for use by their membership and industry.
2004		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Showcase Demonstrations: The Integrated Delivery team will have organized at least 30 full-fledged "Showcase Demonstrations" will very large end-users in the IOF SICs.

OIT's Inventions & Innovations (FY99 Appropriation $ million, FY2000 Request $ million)

By the year 2005, the newly reorganized Inventions and Innovation program, in conjunction with its commercialization and investment community partners, will evaluate 650 submissions per year, recommend 30 per year for funding, realize at least 25% market entry rate for Energy Related Inventions Program and Innovative Concepts technologies funded through FY 2000 resulting in annual energy savings of 103 Trillion Btus per year. This goal will be achieved through a greater emphasis on technologies within the Industries of the Future framework. Relationships with the commercialization and investment communities will be fostered through a network of regional resource centers.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of $'s)			.43	.43	.43	.41	.39	.39	.42	.45	.48	.50
Total Primary Energy Displaced (Trillion Btu)			111.25	112.31	110.75	106.89	101.93	100.67	103.18	107.15	116.89	116.89
Carbon Equivalent Emissions Displaced (MMTCe)			2.11	2.12	2.09	2.01	1.91	1.88	1.85	1.96	2.07	2.07

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	4.80	4.96	4.80	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Research (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Development (%)		.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20
Deployment (%)		.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80
Partner Financial Investment (Millions of $'s)	3.84	3.97	3.84	4.00	4.00	4.00	4.00	4.00	4.00			
Partner Non-Financial Investment (Millions of $'s)	1.53	1.58	1.53	1.59	1.59	1.59	1.59	1.59	1.59			
Partners (Number)	234.00	261.00	290.00	320.00	350.00	380.00	410.00	440.00	470.00			

1996 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$0**
Inventions & Innovations Program: Began discussions with 2 private investment groups.

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$0**
Inventions & Innovations Program: Continue outreach to small technology based business and recent patent recipients. Focus outreach to selected Vision Team Industries.

Estimated Cost (000 $'s): **$1,800**
Actual Cost (000 $'s): **$1,800**
Inventions & Innovations Program: Evaluated 1200 submissions, recommended 35 for funding.

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$0**
Inventions & Innovations Program: Focused outreach to small technology based business and recent patent recipients.

Estimated Cost (000 $'s): **$150**
Actual Cost (000 $'s): **$150**
Inventions & Innovations Program: Held 2 Commercialization Planning Workshops.

Year	Milestone type	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	Description
				ACCOMPLISHED
1996	Other Milestones	$120	$120	Inventions & Innovations Program: Held 6 National Innovation Workshops.
		$440	$440	Inventions & Innovations Program: Initiated Innovated Concepts Cycle 8 and awarded 20 grants of $22,000 each.
		$0	$0	Inventions & Innovations Program: Leveraged Innovative Concepts funding with funding from OIT Aluminum Team.
		$2,100	$2,100	Inventions & Innovations Program: Provided 29 grants.
		$10	$100	Inventions & Innovations Program: Supported continued commercialization activity for 5 ERIP technologies.
1997				Inventions & Innovations Program: At least 84 inventions had sales in 1998 totaling $83,699,408, only 61 are recent enough grantees to count toward GPRA total
			$4,400	Inventions & Innovations Program: Grants awarded to 20 grantees
1998				Inventions & Innovations Program: At least 84 inventions had sales in 1998 totaling $83,699,408, only 61 are recent enough grantees to count toward GPRA total
			$4,400	Inventions & Innovations Program: Grants awarded to 20 grantees
				PLANNED
1999	Market Penetration Milestones	$0		Inventions & Innovations Program: 6 prior granttes with positive technical results will enter the market
	Technology Characteristic Milestones	$2,000		Inventions & Innovations Program: 10 of the FY 1998 grantees will report positive technical results.

Year	Milestone	PLANNED		
2000	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$0**	Inventions & Innovations Program: 6 prior granttes with positive technical results will enter the market
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$2,800**	Inventions & Innovations Program: 14 of the FY 1998 grantees will report positive technical results.
2001	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$0**	Inventions & Innovations Program: 10 prior granttes with positive technical results will enter the market
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$3,000**	Inventions & Innovations Program: 15 of the FY 1998 grantees will report positive technical results.
2002	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$0**	Inventions & Innovations Program: 10 prior granttes with positive technical results will enter the market
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$3,000**	Inventions & Innovations Program: 15 of the FY 1998 grantees will report positive technical results.
2003	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$0**	Inventions & Innovations Program: 10 prior granttes with positive technical results will enter the market
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$3,000**	Inventions & Innovations Program: 15 of the FY 1998 grantees will report positive technical results.
2004	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$0**	Inventions & Innovations Program: 10 prior granttes with positive technical results will enter the market
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$3,000**	Inventions & Innovations Program: 15 of the FY 1998 grantees will report positive technical results.

OIT's Metals Casting Vision (FY99 Appropriation $ million, FY2000 Request $5.797 million)

The Office of Industrial Technologies Metal Casting Program is working in collaboration with the metal casting industry as represented by the Cast Metals Coalition (CMC) which consists of the American Foundrymen's Society, North American Die Casting Association, and Steel Founder's Society of America. The Program will undertake over $5 million dollars of research, development and deployment activities in FY2000 in order to address industry-defined objectives identified in the Vision, Beyond 2000, and the Metal Casting Industry Technology Roadmap. The long term goal is to support metal casting as the preferred supplier of net or near-net shape metal components by the year 2020. In order to meet this goal, the specific challenges which must be achieved include: increasing productivity by 15 percent though the development of advanced technologies, reducing energy consumption by 20 percent, reducing average lead time by 50 percent, achieving 100 percent pre- and post-consumer recycling and 75% beneficial reuse of foundry by-products, and increasing industry reinvestment in research, education and marketing programs by 10 percent. By the year 2005 the Metal Casting Team will have displaced 10.5 TBTU of energy and reduce1,993 tons of SO2, 1,621 tons NOx, 167 tons particulates, and 193 thousand tons carbon equivalents.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of $'s)									.04	.09	.18	.31
Total Primary Energy Displaced (Trillion Btu)									10.50	25.90	55.10	89.20
Carbon Equivalent Emissions Displaced (MMTCe)									.19	.51	1.10	1.87

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	3.50	5.40	5.80	5.90	5.90	6.00	6.00	6.10	6.10	6.10	6.10	6.10
Research (%)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Development (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Deployment (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Partner Financial Investment (Millions of $'s)	1.08	1.40	1.71	1.75	1.78	1.82	1.85	1.88	1.88	1.88	1.88	1.88
Partner Non-Financial Investment (Millions of $'s)	2.52	3.40	6.07	6.19	6.31	6.44	6.55	6.68	6.68	6.68	6.68	6.68
Partners (Number)			270.00	272.00	275.00	278.00	280.00	283.00	283.00	283.00	283.00	283.00

ACCOMPLISHED

1994 Market Penetration Milestones

Estimated Cost (000 $'s):
Actual Cost (000 $'s): **$540**

Metals Casting Vision Program: One commercialized technology. Commercial use of improved measurement system developed for precision castings.

Other Milestones

Estimated Cost (000 $'s):
Actual Cost (000 $'s): **$0**

Metals Casting Vision Program: Leveraged program funds by obtaining a minimum cost share of 50 percent on projects within the program. Leveraged program costs by 50 percent industry cost share.

1995

Estimated Cost (000 $'s):
Actual Cost (000 $'s): **$0**

Metals Casting Vision Program: The Metal Casting Compact was signed with DOE, American Foundrymen's Society, Steel Founders' Society of America, and North American Die Casting Association. Metal Casting Vision was developed.

1996 Market Penetration Milestones

Estimated Cost (000 $'s):
Actual Cost (000 $'s): **$2,100**

Metals Casting Vision Program: Five commercialized/demonstrated technologies: (1) air-gauge system for lost foam production commercialized; (2) automated testing and casting units commercialized; (3) penetration software for sand molds distributed to foundry industry; (4) innovative testing and modeling procedures to predict fatigue life of permanent mold dies demonstrated; and (5) electrohydraulic removal of ceramic shells and cores demonstrated.

Year	Milestone	Cost		ACCOMPLISHED
1997	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$3,000**	Metals Casting Vision Program: Five commercialized/demonstrated technologies: (1) instrumentation demonstrated to accurately assess plant compactor vibration; (2) distortion strip demonstrated to measure casting distortion; (3) measurement device demonstrated to measure the effect of vibration on densification around and into a pattern; (4) origins of steel macro inclusions identified and website developed; and (5) mobile sand reclamation unit commercialized.
	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$0**	Metals Casting Vision Program: Action Plan developed for Metal Casting Team outlining twelve-month responsibilities and timeline for technology transfer, outreach, leveraging, communication, and future solicitation.
1998	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$208**	Metals Casting Vision Program: Application of clean steel casting techniques being transferred in the steel industry to reduce defects.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$0**	Metals Casting Vision Program: Inclusions website being dupdated with additional inclusions data.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$25**	Metals Casting Vision Program: Foundry Energy Assessments - Energy Manual and Microsoft Excel Spreadsheets were developed to assist foundries identify and analyze energy savings measures.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$499**	Metals Casting Vision Program: Improved Die Life - A PC-based expert system for optimizing the die heat treatment cycle and identifying the desired mechanical properties was developed and verified. The expert system is a cost-effective tool that assists in designing die casting dies which will have a longer die life (20 percent). This will result in energy and environmental savings due to the lower frequency of replacing die casting dies.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$106**	Metals Casting Vision Program: Mechanical Properties of Lead Free Copper-base Engineering Alloys in Permanent Molds - Determined the mechanical properties, fracture toughness and fatigue properties of seven lead-free, copper-base engineering alloys in permanent molds. This will enable more rigorous engineering applications, reduction in sand disposal and associated energy system.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$0**	Metals Casting Vision Program: Technology Roadmap - Published Metal Casting Industry Technology Roadmap in January 1998.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$565**	Metals Casting Vision Program: Visualization Tools - A simple qualitative method made available, using PC-based software, to visualize potential design problems in die casting. This will lead to better designs, reduced number of rejects, less scrap and more energy efficient casting operations.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	**$114**	Metals Casting Vision Program: Yield Improvement - Identified techniques for decreasing the size and number of risers required to produce quality castings. These include conventional methods (feeding rules, riser insulation, block chills); and unconventional methods (active heating and cooling, and directional solidification). These techniques can increase casting yield on certain practices by 10 percent for an energy savings of 1.8 TBTU. New techniques may improve yield by 25 percent on an optimized casting system.

			PLANNED
1999	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$0**	Metals Casting Vision Program: Two showcases planned: Lost Foam (October 1998) and Steel Foundry (April 1999).
	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$0**	Metals Casting Vision Program: Increase interagency leveraging.
2000	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$0**	Metals Casting Vision Program: Five additional Commercialized/Demonstrated Technologies.
		Estimated Cost (000 $'s): Actual Cost (000 $'s): **$0**	Metals Casting Vision Program: One showcase planned: Die Casting (November 1999).

OIT's Mining Vision (FY99 Appropriation $ million, FY2000 Request $3 million)

In collaboration with the mining industry as represented by the National Mining Association, the Office of Industrial Technologies will undertake $2 million of near, mid, and long term research and development activities to support the research outlined in "The Future Begins with Mining, a Vision of the Mining Industry of the Future," furthering the national goals of energy and resource efficiency, environmental compatibility, and improved global competitiveness. Over 50 large, medium, and small companies will participate along with other government agencies, national laboratories, universities and states to develop and implement a roadmap toward these goals. Specific targets of this strategy include low cost and efficient production, superior exploration and resource characterization, safe and efficient extraction and processing, responsible emission and by-product management, advanced product development, a positive partnership with government, and improved communication and education.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Total Primary Energy Displaced (Trillion Btu)												
Energy Costs or Savings (Billions of 1995 $'s)												
Carbon Equivalent Emissions Displaced (MMTCe)												

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)												
Research (%)												
Development (%)												
Deployment (%)												
Partner Financial Investment (Millions of $'s)												
Partner Non-Financial Investment (Millions of $'s)												
Partners (Number)												

1998 Other Milestones

PLANNED

Estimated Cost (000 $'s): **$50**

Actual Cost (000 $'s): **$50**

Mining Vision: Develop and publish a crosscutting technology roadmap for the mining industry.

OIT's NICE-3 (FY99 Appropriation $ million, FY2000 Request $ million)

By having funded 110 demonstration projects through FY2000 in collaboration with 40 states, and assuming one-quarter will attain market acceptance within five years of demonstration, replications of 28 NICE3 projects will collectively displace 62 Trillion Btus of energy by 2005.

NICE3 also plans to fund an additional 16 projects per year, from 2001 to 2005, selected from among 1,000 submissions from all 57 states and territories. Emphasis will be on choosing those projects that can have the greatest impact on the Industries of the Future.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of $'s)			.05	.07	.10	.13	.17	.21	.25	.46	.57	.62
Total Primary Energy Displaced (Trillion Btu)			13.28	18.94	25.43	33.03	41.79	51.45	61.78	109.12	137.98	143.52
Carbon Equivalent Emissions Displaced (MMTCe)			.25	.36	.48	.62	.78	.96	1.11	2.00	2.45	2.55

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	5.80	6.00	6.00	7.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Research (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Development (%)		.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50
Deployment (%)		.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50
Partner Financial Investment (Millions of $'s)	11.97	12.38	12.38	14.45	16.51	16.51	16.51	16.51				
Partner Non-Financial Investment (Millions of $'s)	.07	.08	.08	.09	.10	.10	.10	.10				
Partners (Number)	234.00	261.00	297.00	339.00	387.00	435.00	483.00	531.00				

Year	Other Milestones		ACCOMPLISHED
1996	Estimated Cost (000 $'s): Actual Cost (000 $'s):		NICE-3 Program: 18 funded projects
1997	Estimated Cost (000 $'s): Actual Cost (000 $'s):	 **$5,200**	NICE-3 Program: 13 new awards to grantees
	Estimated Cost (000 $'s): Actual Cost (000 $'s):		NICE-3 Program: 21 replications of prior awards
1998	Estimated Cost (000 $'s): Actual Cost (000 $'s):		NICE-3 Program: 10 replications of prior awards
	Estimated Cost (000 $'s): Actual Cost (000 $'s):	 **$3,450**	NICE-3 Program: 9 new awards to grantees

			PLANNED
1999	Market Penetration MIlestones	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$0**	NICE-3 Program: 3 to 4 demonstrated technologies replicate; 12 to 13 cumulative in market.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$5,800**	NICE-3 Program: 3 to 6 grantees will demonstrate technical feasibility (17 to 20 cumulative).
2000	Market Penetration MIlestones	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$0**	NICE-3 Program: 3 to 4 demonstrated technologies replicate; 15 to 17 cumulative in market.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$6,000**	NICE-3 Program: 3 to 6 grantees will demonstrate technical feasibility (17 to 20 cumulative).
2001	Market Penetration MIlestones	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$0**	NICE-3 Program: 3 to 4 demonstrated technologies replicate; 18 to 21 cumulative in market.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$7,000**	NICE-3 Program: 3 to 7 grantees will demonstrate technical feasibility (17 to 20 cumulative).
2002	Market Penetration MIlestones	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$0**	NICE-3 Program: 3 to 4 demonstrated technologies replicate; 21 to 25 cumulative in market.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$8,000**	NICE-3 Program: 4 to 8 grantees will demonstrate technical feasibility (17 to 20 cumulative).
2003	Market Penetration MIlestones	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$0**	NICE-3 Program: 3 to 4 demonstrated technologies replicate; 24 to 29 cumulative in market.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$8,000**	NICE-3 Program: 4 to 8 grantees will demonstrate technical feasibility (17 to 20 cumulative).
2004	Market Penetration MIlestones	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$0**	NICE-3 Program: 3 to 4 demonstrated technologies replicate; 27 to 33 cumulative in market.

2004 Technology Characteristic Milestones

PLANNED	
	NICE-3 Program: 4 to 8 grantees will demonstrate technical feasibility (17 to 20 cumulative).
Estimated Cost (000 $'s):	
Actual Cost (000 $'s):	**$8,000**

OIT's Steel Vision (FY99 Appropriation $ million, FY2000 Request $10.627 million)

By the year 2004 and continuing beyond, the Steel Vision Team, In collaboration with the steel industry, including both integrated and electric furnace producers, will provide the framework for identification of the appropriate areas for joint research, development and technology demonstration. The result will be a research partnership between the Department of Energy and the Steel Industry. The partnership will undertake a multi-million dollar effort of demonstration, evaluation and acceleration of new technologies and scientific insights that will address several specific and crosscutting needs including: Production efficiency - seeking improvement in energy costs, and to produce higher quality products resulting in annual displacement of 0.1 quads of energy saving $230 million; recycling - increasing the role of steel recycling and recovery of iron units from plant solid wastes resulting in 20% solid waste recovery; environmental engineering - achieving further reductions in air and water emissions and generation of hazardous wastes, and to develop new processes to avoid pollution rather than control and treat it resulting in annual reductions of pollutants of nearly 2 million metric tons by 2020.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Total Primary Energy Displaced (Trillion Btu)									14.17	36.34	72.99	110.40
Energy Costs or Savings (Billions of $'s)									.03	.07	.15	.24
Carbon Equivalent Emissions Displaced (MMTons)									.24	.63	1.29	1.94

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	9.06	10.06	11.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00
Research (%)		.20	.20	.15	.10	.10	.15	.15	.15	.15	.15	.15
Development (%)		.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70
Deployment (%)		.10	.10	.15	.20	.20	.15	.15	.15	.15	.15	.15
Partner Financial Investment (Millions of $'s)	2.33	2.33	2.64	2.92	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Partner Non-Financial Investment (Millions of $'s)	.58	.58	.66	.97	1.35	1.53	1.43	1.58	1.58	1.58	1.58	1.58
Partners (Number)		10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

1996 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s): **$20**
Actual Cost (000 $'s): **$20**

Steel Vision Program: Communications Plan complete. Updated quarterly.

Estimated Cost (000 $'s): **$60**
Actual Cost (000 $'s): **$60**

Steel Vision Program: Roadmap - Recycling Chapter complete. Completion extended to December 1997.

1997

Estimated Cost (000 $'s): **$2,000**
Actual Cost (000 $'s): **$2,000**

Steel Vision Program: Dezincing - Pilot scale demonstration completed. Partnership with industry anticipated to facilitate design, construction, and test of commercial prototype. Dependent on private sector funding.

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$0**

Steel Vision Program: Roadmap - 1st version complete and published. Final version due December 1997.

1998 Market Penetration Milestones

ACCOMPLISHED

Estimated Cost (000 $'s): **$350**
Actual Cost (000 $'s): **$10,000**

Steel Vision Program: Commercialize two sensor and control systems. Complercialized laser assisted welding project and gavaneal temperature sensor project (first generation).

Other Milestones

Estimated Cost (000 $'s): **$350**
Actual Cost (000 $'s): **$350**

Steel Vision Program: Commercialize two Sensors - The first commercial Galvanneal Phase Measurement Gauge was installed and is now operating at Stelco, Inc. Temperature measurement of Galvanneal - A commercial vendor has been selected to market the thermographic phosphor measurement system being developed under the Temperature measurement of Galvenneal project.

Estimated Cost (000 $'s): **$2,800**
Actual Cost (000 $'s): **$2,800**

Steel Vision Program: Complete solicitation to industry to conduct R&D responsive to Steel Technology Roadmap.

Estimated Cost (000 $'s): **$1,750**
Actual Cost (000 $'s): **$1,750**

Steel Vision Program: Complete solicitation to the National Laboratories for adaptable/transferable technologies responsive to the Steel Technology Roadmap.

Estimated Cost (000 $'s): **$2,000**
Actual Cost (000 $'s): **$2,000**

Steel Vision Program: Dezincing - Pilot scale demonstration continuing. Identified opportunities for improvement. Anticipate partner for full scale demonstration.

DELAYED

1997

Estimated Cost (000 $'s): **$2,800**
Actual Cost (000 $'s):

Steel Vision Program: Industrial Solicitation - Will be completed 1st quarter of FY98.

Estimated Cost (000 $'s): **$1,750**
Actual Cost (000 $'s):

Steel Vision Program: National Lab Solicitation - Will be completed 1st quarter of FY98.

1998

Estimated Cost (000 $'s): **$150**
Actual Cost (000 $'s):

Steel Vision Program: Implementation Plan - Scheduled for completion 2nd quarter of FY1998.

PLANNED

1999 Market Penetration Milestones

Estimated Cost (000 $'s): **$180**
Actual Cost (000 $'s):

Steel Vision Program: Commercialize one National Laboratory technology.

Other Milestones

Estimated Cost (000 $'s): **$10,000**
Actual Cost (000 $'s):

Steel Vision Program: Complete solicitation to industry to conduct R&D responsive to Steel Technology Roadmap.

Estimated Cost (000 $'s): **$4,000**
Actual Cost (000 $'s):

Steel Vision Program: Complete solicitation to the National Laboratories for adaptable/transferable technologies responsive to the Steel Technology Roadmap.

Year	Category	PLANNED		
2000	Market Penetration Milestones	Estimated Cost (000 $'s): **$3,000** Actual Cost (000 $'s):		Steel Vision Program: Commercialize one new technology resulting from FY97 industry solicitation.
		Estimated Cost (000 $'s): **$350** Actual Cost (000 $'s):		Steel Vision Program: Commercialize two National Laboratory technologies.
	Other Milestones	Estimated Cost (000 $'s): **$10,000** Actual Cost (000 $'s):		Steel Vision Program: Complete solicitation to industry to conduct R&D responsive to Steel Technology Roadmap.
		Estimated Cost (000 $'s): **$4,000** Actual Cost (000 $'s):		Steel Vision Program: Complete solicitation to the National Laboratories for adaptable/transferable technologies responsive to the Steel Technology Roadmap.
		Estimated Cost (000 $'s): **$40** Actual Cost (000 $'s):		Steel Vision Program: Revise and update Steel Technology Roadmap.
2001	Market Penetration Milestones	Estimated Cost (000 $'s): **$350** Actual Cost (000 $'s):		Steel Vision Program: Commercialize two National Laboratory technologies.
		Estimated Cost (000 $'s): **$3,000** Actual Cost (000 $'s):		Steel Vision Program: Commercialize one new technology resulting from FY98 industry solicitation.
	Other Milestones	Estimated Cost (000 $'s): **$10,000** Actual Cost (000 $'s):		Steel Vision Program: Complete solicitation to industry to conduct R&D responsive to Steel Technology Roadmap.
		Estimated Cost (000 $'s): **$4,000** Actual Cost (000 $'s):		Steel Vision Program: Complete solicitation to the National Laboratories for adaptable/transferable technologies responsive to the Steel Technology Roadmap.
2002	Market Penetration Milestones	Estimated Cost (000 $'s): **$3,000** Actual Cost (000 $'s):		Steel Vision Program: Commercialize one new technology resulting from FY99 industry solicitation.
		Estimated Cost (000 $'s): **$400** Actual Cost (000 $'s):		Steel Vision Program: Commercialize two National Laboratory technologies.

Year	Milestone Type			PLANNED
2002	Other Milestones	Estimated Cost (000 $'s):	**$10,000**	Steel Vision Program: Complete solicitation to industry to conduct R&D responsive to Steel Technology Roadmap.
		Actual Cost (000 $'s):		
		Estimated Cost (000 $'s):	**$4,000**	Steel Vision Program: Complete solicitation to the National Laboratories for adaptable/transferable technologies responsive to the Steel Technology Roadmap.
		Actual Cost (000 $'s):		
		Estimated Cost (000 $'s):	**$40**	Steel Vision Program: Revise and update Steel Technology Roadmap.
		Actual Cost (000 $'s):		
2003	Market Penetration Milestones	Estimated Cost (000 $'s):	**$3,000**	Steel Vision Program: Commercialize one new technology resulting from FY2000 industry solicitation.
		Actual Cost (000 $'s):		
		Estimated Cost (000 $'s):	**$400**	Steel Vision Program: Commercialize two National Laboratory technologies.
		Actual Cost (000 $'s):		
	Other Milestones	Estimated Cost (000 $'s):	**$10,000**	Steel Vision Program: Complete solicitation to industry to conduct R&D responsive to Steel Technology Roadmap.
		Actual Cost (000 $'s):		
		Estimated Cost (000 $'s):	**$4,000**	Steel Vision Program: Complete solicitation to the National Laboratories for adaptable/transferable technologies responsive to the Steel Technology Roadmap.
		Actual Cost (000 $'s):		
2004	Market Penetration Milestones	Estimated Cost (000 $'s):	**$3,000**	Steel Vision Program: Commercialize one new technology resulting from FY2001 industry solicitation.
		Actual Cost (000 $'s):		
		Estimated Cost (000 $'s):	**$400**	Steel Vision Program: Commercialize two National Laboratory technologies.
		Actual Cost (000 $'s):		
	Other Milestones	Estimated Cost (000 $'s):	**$10,000**	Steel Vision Program: Complete solicitation to industry to conduct R&D responsive to Steel Technology Roadmap.
		Actual Cost (000 $'s):		
		Estimated Cost (000 $'s):	**$4,000**	Steel Vision Program: Complete solicitation to the National Laboratories for adaptable/transferable technologies responsive to the Steel Technology Roadmap.
		Actual Cost (000 $'s):		

2004 Other Milestones

PLANNED		
Estimated Cost (000 $'s):	**$40**	Steel Vision Program: Revise and update Steel Technology Roadmap.
Actual Cost (000 $'s):		

Office of Power Technologies (OPT)

OPT's Biomass Power R&D (FY99 Appropriation $ million, FY2000 Request $38.95 million)

By 2004, in collaboration with USDA, power producers, manufacturers, farmers, and foresters, and by undertaking research and development activities to increase the viability of clean, efficient, biopower technologies for a variety of markets, the Biomass Power Program will achieve an additional 3,000 MW of new biomass power capacity in the U.S., increasing the total to 10,000 MW of domestic capacity. The program benefits the American taxpayer by: helping to revitalize rural economies by providing jobs linked to renewable power production and co-products such as fuel, fiber, and feed; diverting biomass residues from the waste stream; and improving the environment in the near term through reduction in greenhouse gas emissions.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of 1995 $'s)				.01					-.06	-.15	-.16	-.21
Carbon Equivalent Emissions Displaced (MMTCe)				.62					5.31	10.49	11.83	12.95
Total Primary Energy Displaced (Trillion Btu)				28.00					215.05	422.07	478.32	532.54

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	25.80	26.25	41.00	41.40	41.60	37.00	32.00	32.00	36.50	36.50	36.50	36.50
Research (%)		15.00	15.00	15.00	15.00	15.00	15.00	15.00	10.00	10.00	10.00	10.00
Development (%)		85.00	85.00	80.00	75.00	75.00	70.00	70.00	75.00	70.00	70.00	70.00
Deployment (%)		.00	.00	5.00	10.00	10.00	15.00	15.00	15.00	20.00	20.00	20.00
Partner Financial Investment (Millions of $'s)	3.00	4.00	20.00	20.00	20.00	18.00	16.00	16.00	50.00	50.00	50.00	50.00
Partner Non-Financial Investment (Millions of $'s)	4.00	5.00	20.00	20.00	20.00	19.00	16.00	16.00	.00	.00	.00	.00
Partners (Number)	20.00	20.00	25.00	25.00	25.00	25.00	25.00	30.00	100.00	100.00	100.00	100.00

1997 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$100**

Biomass Power R&D Program: Completed verification and proof-of-concept testing of highly efficient small scale biopower system (BioStirling)

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$200**

Biomass Power R&D Program: Completed "Technology Characterizations" in cooperation with EPRI for direct-fired, cofired, and gasification biomass systems.

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$500**

Biomass Power R&D Program: Tested direct coupling of small (200 kW) gas turbine to medium heat content biomass synthesis gas (produced by BCL gasifier)

Year	Milestone Type	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	Description
		ACCOMPLISHED		
1998	Other Milestones	$1,500	$1,500	Biomass Power R&D Program: Began small biopower initiative.
		$4,000	$6,000	Biomass Power R&D Program: Complete preliminary cofiring tests in multiple utility coal boilers using wood residues, willow, and switchgrass.
		$17,000	$20,500	Biomass Power R&D Program: Completed operational testing of the Vermont 'indirect' gasifier and produced clean biogas.
		$300	$300	Biomass Power R&D Program: Completed pioneering studies on overall emissions of biomass based power systems that demonstrated 'carbon closure'.
		PLANNED		
1999	Technology Characteristic Milestones	$1,000	$0	Biomass Power R&D Program: Completed feasibility studies for, and completed Phase I of, Small Modular Initiative.
		$3,000	$0	Biomass Power R&D Program: Test co-firing retrofits at full scale power plants using 1) wood residues, 2) willow, 3) switchgrass
2000		$2,000	$0	Biomass Power R&D Program: Complete laboratory testing of a fuel cell and 2 types of engines coupled with the lab-scale biomass gasifier.
		$500	$0	Biomass Power R&D Program: Complete resource database for biomass crops and residues.
		$12,000	$0	Biomass Power R&D Program: Complete two system development projects and complete Phase II of Small Modular Systems Initiative.
		$10,000	$0	Biomass Power R&D Program: Demonstrate sustained operation of the total Vermont biomass system (gasifer, gas clean up, and advanced gas turbine).
2001		$3,000	$0	Biomass Power R&D Program: Complete the development of 2 high-yield woody biomass crop clones and release them to nurseries.

			PLANNED
2002	Market Penetration Milestones	Estimated Cost (000 $'s): **$65,000** Actual Cost (000 $'s): **$0**	Biomass Power R&D Program: Complete Biomass Power for Rural Development projects totaling about 150 MW and proving sustainability of biomass energy crops.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$4,000** Actual Cost (000 $'s): **$0**	Biomass Power R&D Program: Complete development of 3 high-yield willow clones which increase yields by at least 20%.
		Estimated Cost (000 $'s): **$16,000** Actual Cost (000 $'s): **$0**	Biomass Power R&D Program: Complete the Small Modular Systems Initiative with two small-scale biomass systems ready for rapid commercialization by the private sector.
2003	Market Penetration Milestones	Estimated Cost (000 $'s): **$20,000** Actual Cost (000 $'s): **$0**	Biomass Power R&D Program: Complete Co-firing Initiative, establishing viability of co-firing for utility scale generation.

OPT's Energy Storage (FY99 Appropriation $ million, FY2000 Request $14.1 million)

The Energy Storage Systems (ESS) R&D program teams with utility, storage device manufacturers, power electronics suppliers, and the emerging renewable energy industry to develop improved, integrated, cost-effective storage systems that can increase the value of solar and wind energy output, help utilities meet peak loads, defer T&D investment, reolve power quality problems, and reduce demand charges for consumers. Specific goals include 1) reducing capital cost from the current $1,000+/kW to $700/kW and 2) minimizing the land area required for a storage system by increasing the energy stored per unit area from 2 kWh per square foot to 5kWh per square foot.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of 1995 $'s)				.00					.00	.00	.00	.00
Carbon Equivalent Emissions Displaced (MMTCe)				.01					.01	.02	.02	.02
Total Primary Energy Displaced (Trillion Btu)				.48					.65	.82	1.02	1.22

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)		3.89	7.00	9.00	10.00	11.00	12.00	12.00	13.00	16.00	21.00	26.00
Research (%)		.25	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25
Development (%)		.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75
Deployment (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Partner Financial Investment (Millions of $'s)	1.00	1.30	3.00	3.90	4.30	4.70	5.10		5.60	6.90	9.00	11.10
Partner Non-Financial Investment (Millions of $'s)	.70	1.70	2.30	2.90	3.20	3.50	3.90		4.20	5.10	6.80	8.40
Partners (Number)		20.00	21.00	22.00	25.00	27.00	29.00		30.00	33.00	35.00	38.00

1996 Market Penetration Milestones

ACCOMPLISHED

Estimated Cost (000 $'s): **$200**
Actual Cost (000 $'s): **$200**

Energy Storage Program: Completed market assessment of batteries for photovoltaic applications showing 1 Mwh of energy storage for each MW of PV installed, for a total of 700 Mwh in 2000 in support of PV alone. The increased use of renewables due to storage hybrids will result in decreased carbon emissions.

Estimated Cost (000 $'s): **$1,000**
Actual Cost (000 $'s): **$1,000**

Energy Storage Program: Delivered first PQ2000 power quality storage system. Developed under a DOE Cooperative Agreement, the 2-MW, 10-second factory-assembled energy storage system will correct power quality events at a commercial location. This project is the first US commercial installation of a complete integrated power quality protection system with master control by the electric utility. The system has achieved increased efficiency with a decreased footprint and has provided the user with substantially increased operational flexibility. Cost-efficient factory-assembly has provided significant cost savings for customers.

Estimated Cost (000 $'s): **$800**
Actual Cost (000 $'s): **$800**

Energy Storage Program: Installation of a 3.5-MW high-capacity, low-maintenance VRLA battery at a lead-acid battery recycling plant in Vernon, CA that will provide multiple benefits to the user. The system will correct power quality events that compromise both productivity and the ability to meet environmental emissions targets, provide peak-shaving, uninterruptible power and carry critical loads for extended periods. This cost-shared project builds on DOE/industry development of the advanced valve-regulated lead-acid (VRLA) batteries.

1997

Estimated Cost (000 $'s): **$1,500**
Actual Cost (000 $'s): **$1,500**

Energy Storage Program: Delivered first Transportable Battery Energy Storage System (2 MW for 15 sec) at utility site.

Year	Milestone type	Cost	Amount	Description
		ACCOMPLISHED		
1997	Market Penetration Milestones	Estimated Cost (000 $'s):	**$500**	Energy Storage Program: Supported design and installation of a 1-MW, 1.25-hour integrated energy storage system at the Metlakatla, AK Indian reserve in Alaska.
		Actual Cost (000 $'s):	**$500**	
	Other Milestones	Estimated Cost (000 $'s):	**$0**	Energy Storage Program: Completed simulated application test of 33 kW for 3 hours advanced battery energy storage system.
		Actual Cost (000 $'s):	**$3,500**	
1998	Market Penetration Milestones	Estimated Cost (000 $'s):		Energy Storage Program: Installed Transportable Battery Energy Storage System (TBESS) (2 MW for 15 sec) at first utility customer site.
		Actual Cost (000 $'s):	**$1,800**	
	Other Milestones	Estimated Cost (000 $'s):	**$0**	Energy Storage Program: Complete industry needs assessment for renewable generation and storage integrated system and define research direction.
		Actual Cost (000 $'s):	**$400**	
	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$1,000**	Energy Storage Program: Complete design of the transportable Advanced Battery Energy Storage System (ABESS) (150 kW for 2 hours) for power management applications.
		Actual Cost (000 $'s):	**$4,500**	
		PLANNED		
1999		Estimated Cost (000 $'s):	**$5,500**	Energy Storage Program: Complete first prototype advanced battery energy storage system for power management applications.
		Actual Cost (000 $'s):	**$0**	
2000	Market Penetration Milestones	Estimated Cost (000 $'s):	**$6,000**	Energy Storage Program: Install and test prototype 150 kW/2hr advanced battery energy storage system for power management at user site.
		Actual Cost (000 $'s):	**$0**	
	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$1,500**	Energy Storage Program: Complete prototype integrated renewable generation and Storage System for remote applications.
		Actual Cost (000 $'s):	**$0**	
2001	Market Penetration Milestones	Estimated Cost (000 $'s):	**$2,000**	Energy Storage Program: Install prototype 300 kW for 4 hours integrated renewable generation and storage system at remote user site and test.
		Actual Cost (000 $'s):	**$0**	
2002	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$7,000**	Energy Storage Program: Complete next generation advanced battery energy storage system for power management.
		Actual Cost (000 $'s):	**$0**	
2003	Market Penetration Milestones	Estimated Cost (000 $'s):	**$10,000**	Energy Storage Program: Install and monitor 5, 200 kW/2hr advanced battery energy storage system (4000kWh) for power management at user site.
		Actual Cost (000 $'s):	**$0**	

		PLANNED		
2003	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$3,000** Actual Cost (000 $'s): **$0**		Energy Storage Program: Complete optimized design and build prototype 300 kW for 4 hours renewable generation and storage system.
2004	Market Penetration Milestones	Estimated Cost (000 $'s): **$4,000** Actual Cost (000 $'s): **$0**		Energy Storage Program: Install and monitor 300 kW for 4 hour renewable generation and storage optimized system at user sites.

OPT's Geothermal Energy R&D (FY99 Appropriation $ million, FY2000 Request $29.5 million)

Working in close cooperation with its stakeholder community, the Geothermal Energy Program has developed a set of goals for the year 2010, as specified in the Geothermal Energy Strategic Plan. These goals, scaled for the year 2004, include:

Strategic Goal 1 - Electric Power Generation: Supply the electrical power needs of 2.5 million US homes (3,300 MW capacity).

Strategic Goal 2 - Direct Use Applications and Geothermal Heat Pumps: Supply the heating, cooling, and hot water needs of 3 million US homes.

Strategic Goal 3 - International Geothermal Development: Meet the basic energy needs of 40 million people in developing countries using US technology (equivalent to 4,000 MW of generation or double current installed capacity).

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of 1995 $'s)				.11					.27	.46	.65	.71
Carbon Equivalent Emissions Displaced (MMTCe)				1.08					3.40	3.10	4.81	4.06
Total Primary Energy Displaced (Trillion Btu)				55.91					130.08	182.25	264.10	247.73

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	30.00	29.50	33.00	29.50	29.00	33.00	35.00	35.00	30.00	30.00	30.00	30.00
Research (%)		8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Development (%)		82.00	82.00	89.00	89.00	89.00	89.00	89.00	89.00	89.00	89.00	89.00
Deployment (%)		10.00	10.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Partner Financial Investment (Millions of $'s)	.00	8.00	8.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Partner Non-Financial Investment (Millions of $'s)	15.00	12.00	22.00	22.00	22.00	22.00	12.00	12.00	12.00	12.00	12.00	12.00
Partners (Number)		50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00

1996 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s): **$500**
Actual Cost (000 $'s):
Geothermal Energy R&D Program: Supersaturated expansion of binary working fluids with brine rate of 9 watt-hours per pound of 360 degree (F) brine (Note: empirical data not gathered for 360 degree (F) brine)

Estimated Cost (000 $'s):
Actual Cost (000 $'s): **$500**
Geothermal Energy R&D Program: Supersaturated expansion of binary working fluids with brine rate of 9 watt-hours per pound of 360 degree (F) brine (Note: empirical data not gathered for 360 degree (F) brine)

Estimated Cost (000 $'s): **$1,500**
Actual Cost (000 $'s):
Geothermal Energy R&D Program: Temperature and pressure tool developed and available to industry

Estimated Cost (000 $'s):
Actual Cost (000 $'s): **$1,500**
Geothermal Energy R&D Program: Temperature and pressure tool developed and available to industry

Year	Milestone Type	Cost		Description
				ACCOMPLISHED
1996	Other Milestones	Estimated Cost (000 $'s):	$5,300	Geothermal Energy R&D Program: Two new major utility and cost-shared GHP (Geothermal Heat Pump) programs; Acquire electric load and system data; 50 GHPC (Geothermal Heat Pump Consortium) members
		Actual Cost (000 $'s):		
		Estimated Cost (000 $'s):		Geothermal Energy R&D Program: Two new major utility cost-shared GHP programs; acquire electric load and system data; 50 utility GHPC members
		Actual Cost (000 $'s):	$5,300	
1997		Estimated Cost (000 $'s):		Geothermal Energy R&D Program: Biphase Rotary Separator Turbine installed and under test at commercial site.
		Actual Cost (000 $'s):	$1,500	
		Estimated Cost (000 $'s):	$700	Geothermal Energy R&D Program: Direct-contact condensers and turbocompressors installed and under test at commercial site.
		Actual Cost (000 $'s):	$700	
		Estimated Cost (000 $'s):		Geothermal Energy R&D Program: Rolling float meter and Doppler flow meter commercialized by industry.
		Actual Cost (000 $'s):	$1,000	
		Estimated Cost (000 $'s):		Geothermal Energy R&D Program: Totaled 60 Geothermal Heat Pump Consortium members representing 200 individual utilities.
		Actual Cost (000 $'s):	$17,300	
1998		Estimated Cost (000 $'s):	$1,000	Geothermal Energy R&D Program: Completed laboratory testing of high temperature micro-processor for downhole measurements.
		Actual Cost (000 $'s):	$1,000	
		Estimated Cost (000 $'s):	$1,000	Geothermal Energy R&D Program: Completed technology transfer of core tube data logger to industry.
		Actual Cost (000 $'s):	$1,000	
		Estimated Cost (000 $'s):	$2,000	Geothermal Energy R&D Program: Provided technology for commercialization of the line-shaft pump alignment system.
		Actual Cost (000 $'s):	$2,000	
		Estimated Cost (000 $'s):	$7,200	Geothermal Energy R&D Program: Startup of Lake County, California Injection pipeline.
		Actual Cost (000 $'s):	$7,200	
				PLANNED
1999	Market Penetration Milestones	Estimated Cost (000 $'s):	$500	Geothermal Energy R&D Program: Technology specific Super ESPC for GHPs is installing greater than 5,000 units annually in coordination with FEMP.
		Actual Cost (000 $'s):		

Year	Milestone Type	Cost	PLANNED
1999	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$1,000** Actual Cost (000 $'s):	Geothermal Energy R&D Program: Complete documentation for planning, designing, drilling, and testing slimholes for exploration.
		Estimated Cost (000 $'s): **$300** Actual Cost (000 $'s):	Geothermal Energy R&D Program: Conduct small scale test of trilateral cycle.
		Estimated Cost (000 $'s): **$2,000** Actual Cost (000 $'s):	Geothermal Energy R&D Program: Cost share exploratory drilling of two wells in Medicine Lake Caldera, California.
		Estimated Cost (000 $'s): **$400** Actual Cost (000 $'s): **$0**	Geothermal Energy R&D Program: Determine effects of grout, loop position, formation, thermal conductivity, on thermal performance of well bore.
		Estimated Cost (000 $'s): **$400** Actual Cost (000 $'s):	Geothermal Energy R&D Program: Document GHP energy savings, and operating and maintenance costs. Determine effects of grout, loop position, formation, thermal conductivity, on thermal performance of well bore.
2000	Market Penetration Milestones	Estimated Cost (000 $'s): **$1,500** Actual Cost (000 $'s):	Geothermal Energy R&D Program: Complete installation of 40MW Biphase Rotary /Steam Turbine Systems
		Estimated Cost (000 $'s): **$2,000** Actual Cost (000 $'s):	Geothermal Energy R&D Program: Complete technology transfer of drillable Stradder packer.
		Estimated Cost (000 $'s): **$1,600** Actual Cost (000 $'s):	Geothermal Energy R&D Program: Incorporation of computer techniques to derive critical geothermal parameters from seismic data into commercial reservoir simulation programs.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$4,200** Actual Cost (000 $'s):	Geothermal Energy R&D Program: Complete 8 MW Kalina Cycle System #11 demonstration power plant
		Estimated Cost (000 $'s): **$1,000** Actual Cost (000 $'s):	Geothermal Energy R&D Program: Conduct research to image fractured reservoirs using 3-D seismic techniques.
2001		Estimated Cost (000 $'s): **$1,500** Actual Cost (000 $'s):	Geothermal Energy R&D Program: Complete field test of 1 MW trilateral cycle power module.

Year	Milestone Type	Cost		PLANNED
2001	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$2,000**	Geothermal Energy R&D Program: Field test and evaluate the expert drilling system with industry.
		Actual Cost (000 $'s):		
2002	Market Penetration Milestones	Estimated Cost (000 $'s):	**$7,000**	Geothermal Energy R&D Program: As a result of cost-shared drilling in Medicine Lake Caldera, industry operates two 40-MW power plants.
		Actual Cost (000 $'s):		
		Estimated Cost (000 $'s):	**$2,000**	Geothermal Energy R&D Program: Commercialize PDC bits that will double penetration rates and bit life.
		Actual Cost (000 $'s):		
		Estimated Cost (000 $'s):	**$1,500**	Geothermal Energy R&D Program: Install 5 MW of trilateral cycle modules.
		Actual Cost (000 $'s):	**$0**	
2003		Estimated Cost (000 $'s):	**$2,000**	Geothermal Energy R&D Program: 3-D seismic used by US geothermal industry in exploration projects.
		Actual Cost (000 $'s):		
		Estimated Cost (000 $'s):	**$6,000**	Geothermal Energy R&D Program: Contract signed for 30 MW power plant using advanced heat rejection.
		Actual Cost (000 $'s):		
	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$6,000**	Geothermal Energy R&D Program: Conduct field verification of advanced energy conversion system.
		Actual Cost (000 $'s):		
2004		Estimated Cost (000 $'s):	**$3,000**	Geothermal Energy R&D Program: Field test prototype high speed Diagnostics-While-Drilling (DWD) System.
		Actual Cost (000 $'s):		

OPT's High Temperature Superconductivity (FY99 Appropriation $32.5 million, FY2000 Request $36 million)

Together with industry, universities, and the national laboratories, the Superconductivity Program for Electric Systems will conduct high-temperature superconductivity (HTS) research that will greatly advance the state of the technology. By 2004, the program seeks to reduce the cost of HTS wire to 1 cent per ampere-meter from over $5 today, and increase its current carrying-capacity performance to 100,000 ampere-meters from 5,000 today. Additionally, the program is supporting prototype device efforts that will be coming to fruition in the next five years: a k HTS transmission cable will be tested in 1998, a 1,000hp HTS motor will be tested in 1999 (and a 5,000hp prototype in 2001), and a 15kV HTS current controller will also be tested in 1999. Under a new solicitation now active, the program will look for additional applications, such as transformers, generators, flywheels, magnetic separators which can demonstrate the advantages of superconductivity. These super-efficient electric power devices, once made commercially available, will help utilities adjust to a competitive environment, and will stimulate growth of this high-tech industry.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of 1995 $'s)				.00					.30	.24	.56	1.03
Carbon Equivalent Emissions Displaced (MMTCe)				.00					.00	.00	.03	.14
Total Primary Energy Displaced (Trillion Btu)				.00					.00	.13	1.79	8.51

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)		31.50	32.50	32.50	32.50	32.50	32.50	32.50	32.50	32.50	32.50	32.50
Research (%)		70.00	70.00	70.00	71.00	72.00	73.00	73.00	74.00	75.00	75.00	75.00
Development (%)		30.00	30.00	30.00	29.00	28.00	27.00	27.00	26.00	25.00	25.00	25.00
Deployment (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Partner Financial Investment (Millions of $'s)	8.00	10.00	10.00	11.00	12.00	13.00	13.00		15.00	17.00	20.00	20.00
Partner Non-Financial Investment (Millions of $'s)		.00	.00	.00	.00	.00	.00		.00	.00	.00	.00
Partners (Number)		34.00	35.00	37.00	39.00	42.00	45.00		50.00	55.00	60.00	65.00

ACCOMPLISHED

1996

Market Penetration Milestones

Estimated Cost (000 $'s): **$8,000**
Actual Cost (000 $'s): **$8,000**

High Temperature Superconductivity Program: Demonstrate world record performance 2.4kV current limiter (Lockheed).

Technology Characteristic Milestones

Estimated Cost (000 $'s): **$4,000**
Actual Cost (000 $'s):

High Temperature Superconductivity Program: Demonstrate IBAD conductor with JC=1x10^6 at 77 K and self-field (LANL)

1997

Market Penetration Milestones

Estimated Cost (000 $'s): **$9,000**
Actual Cost (000 $'s): **$9,000**

High Temperature Superconductivity Program: Demonstrate 115kW power cable (Pirelli); with cable capacity three times greater than copper equivalent.

Other Milestones

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$300**

High Temperature Superconductivity Program: Tested HTS coil with world record magnetic field of 1 Tesla.

Technology Characteristic Milestones

ACCOMPLISHED

Year	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	Milestone
1997	$5,000	$8,000	High Temperature Superconductivity Program: Achieved RABiTS conductor with JC=1x10^6 at 77 K and self-field (ORNL).
1998	$5,500	$6,000	High Temperature Superconductivity Program: Demonstrate 1 MVA high-temperature superconducting transformer.

PLANNED

Year	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	Milestone
1996			High Temperature Superconductivity Program: Test magnetic separator prototype (LANL, Eriez).
1998	$8,000	$16,000	High Temperature Superconductivity Program: Demonstrate-1 meter length of coated conductor with current density of 50,000 A/cm2
1999	$15,000		High Temperature Superconductivity Program: Demonstrate 1000hp motor (Rockwell); half the energy losses of conventional motors
2001	$42,000		High Temperature Superconductivity Program: Demonstrate first long-length (100 meter) coated conductor at 50 Amp level
	$17,000		High Temperature Superconductivity Program: Demonstrate 5000 hp motor with half the energy losses of conventional motors.
2004	$69,000		High Temperature Superconductivity Program: Reduce processing cost of coated conductors to $0.01/A-m.

OPT's Hydrogen (FY99 Appropriation $ million, FY2000 Request $24 million)

In collaboration with the hydrogen, fuel cell, electricity supply and transportation industries, the Hydrogen Program engages in applied research and engineering development in order to reduce costs of producing, storing, and n using hydrogen as an energy carrier for electricity and as a transportation fuel. The overall goal of the Program during the five-year period ending in 2004 is to achieve the following: 1) Technologies will be demonstrated at the process development unit (PDU) level that, compared to current steam methane reforming, will show the potential to reduce the cost of producing hydrogen by 25 percent, improve efficiencies by 15 percent, and reduce emissions by 15 percent. 2) 6 MW of electricity generating peak capacity will be installed. In addition a facility capable of producing 125,000 scf per day of hydrogen from refuse derived fuel (RDF), agricultural waste, or sewer sludge will be operating. 3) Seventy public transit, fleet and mining vehicles will be operation running on hydrogen or hydrogen/natural gas blends from an on-board storage system, and five hydrogen-refueling stations will be in operation. 4) The production of hydrogen from sunlight and water will be demonstrated at the PDU level representing a cost of no more than $15/MMBtu. During the five-year period, hydrogen produced from steam methane reforming (SMR) will begin to penetrate niche markets in both the utility and the transportation sectors, and renewable hydrogen production technologies will be demonstrated at the pilot plant level.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of 1995 $'s)				-.01					-.05	.10	.51	.71
Carbon Equivalent Emissions Displaced (MMTCe)				.06					.62	1.34	3.66	9.31
Total Primary Energy Displaced (Trillion Btu)				4.46					43.00	92.44	252.62	641.86

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)		13.25	24.00	24.00	25.00	27.00	37.00	40.00	13.00	16.00	21.00	26.00
Research (%)		20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Development (%)		80.00	80.00	80.00	75.00	70.00	70.00	70.00	60.00	55.00	55.00	55.00
Deployment (%)		.00	.00	.00	5.00	10.00	10.00	10.00	20.00	25.00	25.00	25.00
Partner Financial Investment (Millions of $'s)	2.85	4.40	7.60	10.00	12.00	14.00	16.00	18.00	5.60	6.90	9.00	11.10
Partner Non-Financial Investment (Millions of $'s)		1.20	.90	1.00	1.20	1.40	1.60	1.80				
Partners (Number)		27.00	23.00	25.00	28.00	30.00	32.00	34.00	30.00	33.00	35.00	38.00

1996 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s): **$500**
Actual Cost (000 $'s):

Hydrogen Program: STRATEGY 3: PDU, PV/Electrolysis, 400 kW

1997

Estimated Cost (000 $'s):
Actual Cost (000 $'s): **$1,900**

Hydrogen Program: Constructed outdoor biocatalysis PDU for Scale-up Facilities.

Estimated Cost (000 $'s): **$1,300**
Actual Cost (000 $'s): **$1,300**

Hydrogen Program: Operate PDU electrolysis system for three personal utility vehicles and one neighborhood utility vehicle for Palm Desert, CA.

1998

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$200**

Hydrogen Program: Delivered 3 personal utility vehicles and one neighborhood utility vehicle to Palm Desert, CA.

		ACCOMPLISHED		
1998	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$2,800** Actual Cost (000 $'s): **$2,300**		Hydrogen Program: Designed and installed 2 column sorbent enhanced SMR-PDU
		Estimated Cost (000 $'s): **$100** Actual Cost (000 $'s): **$100**		Hydrogen Program: Operated 1 hydrogen/natural gas blend vehicle.
		Estimated Cost (000 $'s): **$200** Actual Cost (000 $'s): **$200**		Hydrogen Program: Operated 2 hydrogen fueling stations.
		Estimated Cost (000 $'s): **$300** Actual Cost (000 $'s): **$300**		Hydrogen Program: Reversible Fuel Cell tested single cell.
		Estimated Cost (000 $'s): **$900** Actual Cost (000 $'s): **$900**		Hydrogen Program: Tested prototype Fiber-Optic Hydrogen Leak Detector.
		PLANNED		
		Estimated Cost (000 $'s): **$2,100** Actual Cost (000 $'s): **$2,300**		Hydrogen Program: Operated reformer/bioreactor system with H2 production rate of 300ml/min.
1999	Market Penetration Milestones	Estimated Cost (000 $'s): **$900** Actual Cost (000 $'s): **$0**		Hydrogen Program: Field test fiber optic H2 detector.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$1,600** Actual Cost (000 $'s): **$0**		Hydrogen Program: Demonstrate 4 kW PEMFC stack at greater than 53% efficiency.
		Estimated Cost (000 $'s): **$500** Actual Cost (000 $'s): **$0**		Hydrogen Program: Demonstrate greater than 11250 psi burst pressure for hydrogen tank.
		Estimated Cost (000 $'s): **$300** Actual Cost (000 $'s): **$0**		Hydrogen Program: Install renewable refueling station.
2000	Market Penetration Milestones	Estimated Cost (000 $'s): **$2,000** Actual Cost (000 $'s): **$0**		Hydrogen Program: Evaluate 100 kW HBr Reversible Fuel Cell.

Year	Milestone Type	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	PLANNED
2000	Market Penetration Milestones	**$5,000**	**$0**	Hydrogen Program: Install and operate 50 kW electricity and hydrogen refueling station to supply hydrogen for 15 hydrogen/NG blend vehicles and 1 hydrogen bus.
		$2,800	**$0**	Hydrogen Program: Install liquid fueled reformer at remote site.
	Other Milestones	**$360**	**$0**	Hydrogen Program: Standards for Hydrogen Compressed Gas Tanks and Connectors Adopted by ISO.
	Technology Characteristic Milestones	**$900**	**$0**	Hydrogen Program: Achieve high pressure cryotank storage capable of 7% hydrogen by weight.
		$900	**$0**	Hydrogen Program: Demonstrate 6000 hours lifetime; greater than 10% efficient tandem cell.
		$2,500	**$0**	Hydrogen Program: Develop 10% oxygen-tolerant mutant.
		$5,500	**$0**	Hydrogen Program: Install and operate full-scale PDU sorbent enhanced reforming.
2001	Market Penetration Milestones	**$1,500**	**$0**	Hydrogen Program: Install cryogenic tank on industry vehicle.
		$3,000	**$0**	Hydrogen Program: Integrate reversible PEMFC with 100 kW wind turbine.
		$5,500	**$0**	Hydrogen Program: Scale up Sorbent Enhanced Reformer to size suitable for commercial operation.
	Other Milestones	**$100**	**$0**	Hydrogen Program: Handbook for Safe use of Hydrogen Completed.

		PLANNED		
2001	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$1,900** Actual Cost (000 $'s): **$0**		Hydrogen Program: Demonstrate chemical hydride storage on vehicle.
		Estimated Cost (000 $'s): **$3,600** Actual Cost (000 $'s): **$0**		Hydrogen Program: Operate Biocatalysis pilot plant.
		Estimated Cost (000 $'s): **$700** Actual Cost (000 $'s): **$0**		Hydrogen Program: Test solar thermal and PV/PEMFC test bed in Native American Village
2002	Market Penetration Milestones	Estimated Cost (000 $'s): **$4,800** Actual Cost (000 $'s): **$0**		Hydrogen Program: Evaluate 50 kW SMR/PEM combined dispersion electric generating and refueling stateion providing hydrogen in addition to electricity and capable of serving at least 10 hydrogen fueled vehicles.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$3,400** Actual Cost (000 $'s): **$0**		Hydrogen Program: Operate single-stage photobioreactor with oxygen-tolerate mutant.
		Estimated Cost (000 $'s): **$1,000** Actual Cost (000 $'s): **$0**		Hydrogen Program: Test 5% by weight metal hydride storage/FC system.
		Estimated Cost (000 $'s): **$1,500** Actual Cost (000 $'s): **$0**		Hydrogen Program: Test fullerene H2 storage prototype system.
		Estimated Cost (000 $'s): **$900** Actual Cost (000 $'s): **$0**		Hydrogen Program: Test thermocatalytic processor with 5kW FC
2003	Market Penetration Milestones	Estimated Cost (000 $'s): **$3,500** Actual Cost (000 $'s): **$0**		Hydrogen Program: Evaluate biomass hydrogen for filling station with 50 kW generation.
		Estimated Cost (000 $'s): **$3,000** Actual Cost (000 $'s): **$0**		Hydrogen Program: Operate and test Biomass Pyrolysis Engineering Development Unit (EDU) in cost-shared project with industry.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$1,300** Actual Cost (000 $'s): **$0**		Hydrogen Program: Operate 1 kW solid oxide, high pressure, high temperature electrolysis unit.

2004	Market Penetration Milestones	**PLANNED**	
		Estimated Cost (000 $'s): **$5,000** Actual Cost (000 $'s): **$0**	Hydrogen Program: Design coal-based sorption enhanced reformer and Chemical Hydride centralized demonstration with CO2 sequestration.
		Estimated Cost (000 $'s): **$4,100** Actual Cost (000 $'s): **$0**	Hydrogen Program: Reversible PEMFC with 2 MW wind farm.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$2,600** Actual Cost (000 $'s): **$0**	Hydrogen Program: Complete pilot plant for nanostructure production.
		Estimated Cost (000 $'s): **$2,800** Actual Cost (000 $'s): **$0**	Hydrogen Program: Photoelectrochemical (PLC) system validation.

OPT's Hydropower (FY99 Appropriation $ million, FY2000 Request $7 million)

By 2004, in collaboration with industry and other Federal Agencies, the Hydropower Program's research and development activities will provide a biological and engineering basis for advanced "environmentally friendly" hydropower turbines, successful development of which would reduce turbine-induced fish mortality to 2% or less, compared to current levels ranging up to 30% or greater, and improve dissolved oxygen concentrations to at least 6 ml/liter, ensuring compliance with EPA and state water quality standards.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of 1995 $'s)				.02					.05	.20	.37	.53
Carbon Equivalent Emissions Displaced (MMTCe)				.15					.48	1.35	2.69	3.00
Total Primary Energy Displaced (Trillion Btu)				7.93					25.18	79.69	147.93	183.04

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	1.00	.75	4.00	7.00	9.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00
Research (%)		90.00	80.00	80.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00
Development (%)		10.00	20.00	20.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Deployment (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Partner Financial Investment (Millions of $'s)		.02	.40	1.50	2.70	4.00	5.00	5.00	5.00			
Partner Non-Financial Investment (Millions of $'s)	.15	.15	.15	.15	.15	.15	.15	.15	.15	.15		
Partners (Number)	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00		

ACCOMPLISHED

1997 Other Milestones

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$1,500**

Hydropower Program: Completed Advanced Hudroturbine conceptual designs.

1998

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$500**

Hydropower Program: Hydropower resource assessment completed for all 50 states.

PLANNED

2000 Technology Characteristic Milestones

Estimated Cost (000 $'s): **$4,000**
Actual Cost (000 $'s): **$0**

Hydropower Program: Complete experiments to establish biologically-based performance criteria for advanced turbine design.

Estimated Cost (000 $'s): **$3,000**
Actual Cost (000 $'s): **$0**

Hydropower Program: Complete proof-of-concept testing of 1997 conceptual design.

2001

Estimated Cost (000 $'s): **$10,000**
Actual Cost (000 $'s): **$0**

Hydropower Program: Complete model testing of turbines with advanced dissolved oxygen features.

		PLANNED		
2002	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$5,000** Actual Cost (000 $'s): **$0**	Hydropower Program: Complete final engineering design for turbines with advanced fish passage features.
2003		Estimated Cost (000 $'s): **$15,000** Actual Cost (000 $'s): **$0**	Hydropower Program: Complete model testing of turbines with advanced fish passage features.

OPT's Photovoltaic Systems R&D (FY99 Appropriation $66.5 million, FY2000 Request $84 million)

By 2005, in partnership with the photovoltaic industry, universities, and national laboratories, the National Photovoltaic R&D Program will 1) increase the efficiency of commercial thin film modules from the current 7% to 12% and from the current 14% to 17% for crystalline silicon; 2) reduce wholesale factory prices of commercial modules by 40% from the current price of $3.80-$4.25/Watt; 3) increase the lifetime of fielded systems from the current 10-15 years to greater than 22 years; and 4) increase the U.S. PV industry cumulative sales of power modules by 300% from 200 megawatts in 1996 to greater than 600 megawatts (U.S. and export sales combined). By 2005 the U.S. PV industry will have captured 50% of the world market.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of 1995 $'s)	.00	.00	.00	.00					.00	.02	.05	.16
Carbon Equivalent Emissions Displaced (MMTCe)				.00					.02	.08	.24	.72
Total Primary Energy Displaced (Trillion Btu)				.25					1.15	5.85	16.56	49.38

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	60.00	65.50	78.80	80.50	84.00	84.00	80.00	76.00	75.00	75.00	75.00	75.00
Research (%)		21.00	19.00	20.00	20.00	20.00	20.00	20.00	13.00	13.00	13.00	13.00
Development (%)		63.00	60.00	63.00	63.00	63.00	63.00	63.00	61.00	61.00	61.00	61.00
Deployment (%)		16.00	21.00	17.00	17.00	17.00	17.00	17.00	26.00	26.00	26.00	26.00
Partner Financial Investment (Millions of $'s)	2.00	2.00	2.50	2.50	2.50	6.50	2.50	2.50	30.00	30.00	30.00	30.00
Partner Non-Financial Investment (Millions of $'s)	.00	.00	.00	.00	.00	.00	.00	.00	2.00	2.00	2.00	2.00
Partners (Number)	20.00	20.00	20.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00

ACCOMPLISHED

1996 Other Milestones

Estimated Cost (000 $'s): **$2,800**
Actual Cost (000 $'s): **$2,800**

Photovoltaic Systems R&D Program: Complete PV:BONUS Phase 3 contracts resulting in 5MW of new building integrated products such as the PV shingle.

Estimated Cost (000 $'s): **$3,300**
Actual Cost (000 $'s):

Photovoltaic Systems R&D Program: Complete PV:BONUS Phase 3 contracts resulting in 5MW of new building integrated products such as the PV shingle.

1997

Estimated Cost (000 $'s): **$1,900**
Actual Cost (000 $'s): **$4,000**

Photovoltaic Systems R&D Program: Completed PV:BONUS field testing and product assessment and initiated solicitation for second-generation product development.

Estimated Cost (000 $'s):
Actual Cost (000 $'s): **$8,000**

Photovoltaic Systems R&D Program: Reduce processing cost of PV systems resulting in module price reduction to $3.80-4.25 range.

1998 Market Penetration Milestones

Estimated Cost (000 $'s): **$3,000**
Actual Cost (000 $'s): **$5,000**

Photovoltaic Systems R&D Program: 500 PV systems installed through industry/utility partnerships.

Year	Milestone Type	Cost	Description
		ACCOMPLISHED	
1998	Market Penetration Milestones	Estimated Cost (000 $'s): **$12,000** Actual Cost (000 $'s): **$9,000**	Photovoltaic Systems R&D Program: Increased U.S. industry sales by 20% through PVMaT and UPVG projects.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$4,000** Actual Cost (000 $'s): **$4,000**	Photovoltaic Systems R&D Program: Developed a 17% efficient laboratory thin-film PV cell.
		PLANNED	
1999		Estimated Cost (000 $'s): **$3,000** Actual Cost (000 $'s):	Photovoltaic Systems R&D Program: Achieve 8.5% efficient thin-film CdTe modulel and demonstrate large area uniformity.
2000		Estimated Cost (000 $'s): **$3,500** Actual Cost (000 $'s):	Photovoltaic Systems R&D Program: Achieve stable 13% efficiency with amorphous silicon thin-film cell.
2001		Estimated Cost (000 $'s): **$4,000** Actual Cost (000 $'s):	Photovoltaic Systems R&D Program: Complete development of at least 5 new PV building integrated products under PV:BONUS 2.
		Estimated Cost (000 $'s): **$2,000** Actual Cost (000 $'s):	Photovoltaic Systems R&D Program: Test a low-cost stable module encapsulant with projected 30-year life.
2003	Market Penetration Milestones	Estimated Cost (000 $'s): **$7,000** Actual Cost (000 $'s):	Photovoltaic Systems R&D Program: Reduce retail price of modules by 30% from 1997 baseline of $3.80 - $4.25/Watt
2004		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**	Photovoltaic Systems R&D Program: Achieve 550 MW cumulative sales by U.S. firms.

OPT's Power Systems Integration (FY99 Appropriation $ million, FY2000 Request $4 million)

By 2004, in collaboration with electric power and energy industries and through research, development and prototype evaluation of advanced power delivery information and control technologies, the Power System Integration and Reliability Program will increase the flexibility, capacity, and efficiency of the U.S. transmission and distribution system. These technologies will enable increased utilization of renewable energy sources, increase customer choice in power quality and self-generation options, provide the capability for information flow needed for the efficient operation of competitive markets, and result in significant reduction of air emissions. The Program will provide analyses and advanced technology options to monitor and operate future power systems, enable the distributed utility option that integrate natural gas and electric power delivery benefits, and aid in alleviating current uncertainties in the utility industry regarding network stability and resiliancy arising from restructuring.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Total Primary Energy Displaced (Trillion Btu)				22.94					118.64	123.92	128.76	132.13
Energy Costs or Savings (Billions of 1995 $'s)				.00					.00	.00	.00	.00
Carbon Equivalent Emissions Displaced (MMTCe)				.50					2.61	2.70	2.77	2.82

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)		1.00		4.00	4.00	4.00	6.00	8.00	8.00	8.00	8.00	
Research (%)		20.00	20.00	20.00	20.00	20.00	20.00	10.00	10.00	10.00	10.00	10.00
Development (%)		80.00	80.00	80.00	80.00	70.00	70.00	80.00	80.00	80.00	80.00	80.00
Deployment (%)		.00	.00	.00	.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Partner Financial Investment (Millions of $'s)				.50	1.50	3.00	6.00	8.00				
Partner Non-Financial Investment (Millions of $'s)		.50	.50	.50	1.00	2.00	2.00	2.00				
Partners (Number)		1.00	1.00	2.00	5.00	8.00	10.00	10.00				

Technology Characteristic Milestones

PLANNED

2000

Estimated Cost (000 $'s): **$1,000**
Actual Cost (000 $'s): **$0**

Power Systems Integration Program: Complete assessment of composite material conductors.

2001

Estimated Cost (000 $'s): **$500**
Actual Cost (000 $'s): **$0**

Power Systems Integration Program: Complete evaluation of high-efficiency power electronic converter configuration.

2002

Estimated Cost (000 $'s): **$2,000**
Actual Cost (000 $'s): **$0**

Power Systems Integration Program: Complete advanced system concept studies of distributed generation and storage technologies and initiate modeling of selected concepts.

2004

Estimated Cost (000 $'s): **$2,000**
Actual Cost (000 $'s): **$0**

Power Systems Integration Program: Evaluate large silicone carbide switching device for high voltage power electronics applications.

OPT's Solar Buildings (FY99 Appropriation $ million, FY2000 Request $5.5 million)

By 2003, through research, development, and field evaluation activities in collaboration with home builder, utility, and solar industry partners, the Solar Building Technology Program will reduce the cost of and improve the performance and reliablity of solar systems designed for heating water and air in residential, industrial, and commercial buildings. Specific five year goals for hte progrma include 1) reducing the delivered life-cycle energy cost of solar water heating systems from .08$/kWh to .04$/kWh, 2) reaching 65,000 in annual U.S. sales for solar water heating systems, and 3) growing U.S. solar thermal technology exports by 200% over 1997 levels.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of 1995 $'s)									.07	.15	.30	.75
Carbon Equivalent Emissions Displaced (MMTCe)				.05					.21	.47	.95	1.70
Total Primary Energy Displaced (Trillion Btu)				3.10					13.14	30.46	60.48	112.32

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	5.00	5.00	5.00	5.50	5.50	5.50	5.00	5.00	5.00	5.00	5.00	5.00
Research (%)		30.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Development (%)		35.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Deployment (%)		35.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Partner Financial Investment (Millions of $'s)	.90	2.20		3.00	3.00	3.00	3.00	3.00				
Partner Non-Financial Investment (Millions of $'s)												
Partners (Number)	15.00	20.00	30.00	30.00	30.00	30.00	30.00	30.00				

1997 Other Milestones

ACCOMPLISHED

Year	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	Milestone
1997	**$0**	**$500**	Solar Buildings Program: In collaboration with builders, utilities, and the solar industry, developed a new strategic plan and identified the technology improvements necessary for the widespread acceptance of solar water heaters.
	$0	**$600**	Solar Buildings Program: Initiated industry cost-shared initiative for development of prototype next generation (low-cost) solar water heating.
	$0	**$200**	Solar Buildings Program: Supported the Solar Rating and Certification Corp. (SRCC) in developing computer models that predict the performance of solar water heaters SRCC certification is now required by HUD.
1998	**$0**	**$500**	Solar Buildings Program: Completed the new feasibility phase of eight R&D contracts for new concepts that could lower the cost of solar water heating. Also, completed the first phase of two contracts studying new applications of solar energy.
	$0	**$200**	Solar Buildings Program: Supported the Solar Rating and Certification Corp. (SRCC) in making U.S. standards for solar water heaters compatible with international standards. SRCC certification now required by states (e.g. Colorado) and financial organizations (e.g. GMAC) sponsoring solar water heating programs.

Year	Milestone Type			PLANNED
1998	Other Milestones	Estimated Cost (000 $'s):	**$0**	Solar Buildings Program: Initiated collaborative efforts with five utilities and two national homebuilders to evaluated solar water heaters and encourage greater private sector acceptance of the technology.
		Actual Cost (000 $'s):	**$1,100**	
1999	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$3,500**	Solar Buildings Program: Establish baseline concepts for a new generation, low-cost solar water heater that has the potential to reduce cost by 50% to $.04/kWh.
		Actual Cost (000 $'s):	**$0**	
2000	Market Penetration Milestones	Estimated Cost (000 $'s):	**$2,000**	Solar Buildings Program: Complete task that develops educational material addressing community codes, covenants, and restrictions that inhibit the use of solar energy.
		Actual Cost (000 $'s):	**$0**	
2001	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$3,500**	Solar Buildings Program: Evaluate prototype concepts for new generation solar water heater, and select system for further development
		Actual Cost (000 $'s):	**$0**	
2003	Market Penetration Milestones	Estimated Cost (000 $'s):	**$2,000**	Solar Buildings Program: Complete task with Solar Rating and Certification Corporation to predict the reliability of solar water heating systems.
		Actual Cost (000 $'s):	**$0**	
	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$3,000**	Solar Buildings Program: Complete field tests of new generation solar water heater.
		Actual Cost (000 $'s):	**$0**	
2004	Market Penetration Milestones	Estimated Cost (000 $'s):	**$0**	Solar Buildings Program: Complete guidelines for state certification programs for installers of solar water heating systems.
		Actual Cost (000 $'s):	**$0**	
	Technology Characteristic Milestones	Estimated Cost (000 $'s):	**$3,000**	Solar Buildings Program: Complete development of solar water heater technology with a life cycle $0.04/kWh and capital cost of $1200.
		Actual Cost (000 $'s):	**$0**	

OPT's Solar International (FY99 Appropriation $3.4 million, FY2000 Request $6 million)

By 2004, the U.S. Initiative on Joint Implementation (USIJI) seeks to achieve "meaningful participationn" by developing countries in the United Nations Framework Convention on Climate Change (UNFCCC) to minimize the adverse effects of climate change by curbing their emissions of greenhouse gas (GHG) emissions by utilizing renewable energy, energy efficiency, and "clean" technologies to facilitate sustainable development. Developing countries contribute to meaningful participation by implementing joing implementation (JI) projects and by facilitating efforts to their private sector to implement jointly sustainable development projects with the U.S. private sector as well as by accepting their responsibility to reduce/mitigate the growth in GHG emissions. USIJI encourages and promotes developing country efforts to reduce emissions through these private sector projects while simultaneously enabling U.S. interests to benefit from the reduction due to joint implementation projects and from the in-country commercial foothold. Carbon emissions displaced reflect expected accumulated annual carbon savings from approved projects, assuming 30 year life and a 50% project implementation rate.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Total Primary Energy Displaced (Trillion Btu)												
Energy Costs or Savings (Billions of 1995 $'s)												
Carbon Equivalent Emissions Displaced (MMTCe)	2.70	3.80	4.10	4.50	5.00	5.50	6.00	6.50	7.20	10.50	14.00	18.00

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	.80	1.38	3.40	2.50	2.50	2.50	2.50	2.50	7.00	7.00	7.00	7.00
Research (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Development (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Deployment (%)		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Partner Financial Investment (Millions of $'s)	15.00	20.00	25.00	25.00	25.00	20.00	20.00	20.00	10.00	10.00	10.00	10.00
Partner Non-Financial Investment (Millions of $'s)	5.00	5.00	10.00	10.00	15.00	15.00	10.00	10.00				
Partners (Number)	25.00	30.00	40.00	40.00	30.00	30.00	20.00	20.00	30.00	30.00	30.00	30.00

1996 Market Penetration Milestones

1997 Other Milestones

ACCOMPLISHED

Year	Cost	Accomplishment
1996	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$3,900**	Solar International Program: Expand international strategy to Asia/Pacific region. Approve 3 Projects for initiative on Joint Implementation.
1997	Estimated Cost (000 $'s): Actual Cost (000 $'s): **$250**	Solar International Program: Accepted 11 projects into the JI program of which 5 have established baseline scenarios representing 163 million metric tons of CO2 sequestered/displaced over the project life at an aggregate investment of $15 million by investor organizations.
	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$250**	Solar International Program: Co-sponsored 7 technical assistance and training workshops in Bolivia, India, South Africa, Chile, Egypt, and Mexico
1998	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$300**	Solar International Program: Accepted 8 projects into the JI program which have established a baseline scenario representing 67 million metric tons of CO2 sequestered/displaced over the project life at an aggregate investment of $23.3 million by investor organizations.

Year	Milestone type	Status	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	Description
1998	Other Milestones	ACCOMPLISHED	$0	$200	Solar International Program: Co-sponsored 5 technical assistance and training workshops in Canada, Japan, China, Malaysia, and South Africa.
			$0	$300	Solar International Program: Provided technical assistance to 4 countries interested in participating in the UNFCCC and implementing a JI program.
1996	Market Penetration Milestones	PLANNED	$6,700		Solar International Program: Expand international strategy into the Asia/Pacific region. Approve 3-5 projects for inclusion in the Initiative on Joint Implementation program. Provide Energy Efficiency Centers an enhanced connection to the Internet.
1999			$500	$0	Solar International Program: Co-sponsor 5 Clean Development Mechanism (CDM) workshops in Asia, Africa, and Latin America.
			$1,000	$0	Solar International Program: Provide technical assistance to 10 countries interested in participating in the UNFCCC and implementing a JI program.
	Other Milestones		$500	$0	Solar International Program: Review approximately 35 applications and accept approximately 10 projects into the JI program which have established a baseline scenario representing 20 million metric tons of CO2 sequestered/displaced over the project life at an aggregate private sector cost of $25 million.
2000	Market Penetration Milestones		$500	$0	Solar International Program: Co-sponsor 5 CDM workshops: in Asia, Africa, and Latin America
			$600	$0	Solar International Program: Provide technical assistance to 6 countries interested in participating in the UNFCCC and implementing a JI program.
			$400	$0	Solar International Program: Review approximately 35 applications and accept approximately 10 projects into the JI program which have established a baseline scenario representing 25 million metric tons of CO2 sequestered/displaced over the project life at an aggregate private sector cost of $25 million.
2001			$600	$0	Solar International Program: Provide technical assistance to 6 countries interested in participating in the UNFCCC and implementing a JI program.
			$400	$0	Solar International Program: Review approximately 35 applications and accept approximately 10 projects into the JI program which have established a baseline scenario representing 25 million metric tons of CO2 sequestered/displaced over the project life at an aggregate private sector cost of $25 million.

Year	Milestones	PLANNED		
2002	Market Penetration Milestones	Estimated Cost (000 $'s): **$600** Actual Cost (000 $'s): **$0**		Solar International Program: Provide technical assistance to 6 countries interested in participating in the UNFCCC and implementing a JI program.
		Estimated Cost (000 $'s): **$400** Actual Cost (000 $'s): **$0**		Solar International Program: Review approximately 35 applications and accept approximately 10 projects into the JI program which have established a baseline scenario representing 30 million metric tons of CO_2 sequestered/displaced over the project life at an aggregate private sector cost of $20 million.
2003		Estimated Cost (000 $'s): **$600** Actual Cost (000 $'s): **$0**		Solar International Program: Provide technical assistance to 6 countries interested in participating in the UNFCCC and implementing a JI program.
		Estimated Cost (000 $'s): **$400** Actual Cost (000 $'s): **$0**		Solar International Program: Review approximately 40 applications and accept approximately 11 projects into the JI program which have established a baseline scenario representing 30 million metric tons of CO_2 sequestered/displaced over the project life at an aggregate private sector cost of $20 million.
2004		Estimated Cost (000 $'s): **$600** Actual Cost (000 $'s): **$0**		Solar International Program: Provide technical assistance to 6 countries interested in participating in the UNFCCC and implementing a JI program.
		Estimated Cost (000 $'s): **$400** Actual Cost (000 $'s): **$0**		Solar International Program: Review approximately 40 applications and accept approximately 12 projects into the JI program which have established a baseline scenario representing 35 million metric tons of CO_2 sequestered/displaced over the project life at an aggregate private sector cost of $20 million.

OPT's Solar Thermal (FY99 Appropriation $ million, FY2000 Request $28.74 million)

By 2004, in collaboration with U.S. industry, the advanced technology developed through the Concentrating Solar Power (CSP) Program will result in reliable (4,000 hrs mean time between failure) distributed and competitively priced (.06-.08$/kWh) dispatchable CSP systems which will enable full participation by CSP systems in domestic generation markets, prompted by teh restructuring activities in various States. The development of CSP technologies will improve our nation's energy security through greater diversity of supply, reduce greenhouse emissions, and create business opportunities for U.S. industry both here and abroad, resulting in high-wage jobs for U.S. workers.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of 1995 $'s)				.00					.00	.01	.04	.09
Carbon Equivalent Emissions Displaced (MMTCe)				.00					.01	.06	.21	.42
Total Primary Energy Displaced (Trillion Btu)				.00					.37	4.04	14.18	29.21

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	22.50	16.80	22.50	18.70	18.70	18.30	18.00	18.00	19.50	19.50	19.50	19.50
Research (%)		29.00	17.00	22.00	29.00	24.00	21.00	19.00	40.00	40.00	40.00	40.00
Development (%)		71.00	83.00	78.00	71.00	76.00	79.00	81.00	60.00	60.00	60.00	60.00
Deployment (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Partner Financial Investment (Millions of $'s)	5.80	5.00	8.60	10.00	10.00	10.00	20.00	30.00	150.00	350.00	500.00	600.00
Partner Non-Financial Investment (Millions of $'s)	1.80	1.30	1.50	2.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00
Partners (Number)	20.00	22.00	24.00	26.00	26.00	26.00	26.00	26.00	20.00	30.00	40.00	50.00

ACCOMPLISHED

1996 Market Penetration Milestones

Estimated Cost (000 $'s): **$4,500**
Actual Cost (000 $'s): **$4,500**

Solar Thermal Program: Completed Phase I design prototype USJVP dish/engine system (2 yrs funding).

Estimated Cost (000 $'s): **$44,000**
Actual Cost (000 $'s): **$44,000**

Solar Thermal Program: Completed Construction of Solar Two Power Tower in 1996 (4 yrs funding).

Estimated Cost (000 $'s): **$1,000**
Actual Cost (000 $'s): **$1,000**

Solar Thermal Program: Completed design of advanced receiver for power towers

Technology Characteristic Milestones

Estimated Cost (000 $'s): **$1,500**
Actual Cost (000 $'s): **$1,500**

Solar Thermal Program: Completed Phase I technology evaluation of heliostat contract under SolMaT and reduced manufacturing costs by 60%.

1997 Other Milestones

Estimated Cost (000 $'s): **$0**
Actual Cost (000 $'s): **$22,500**

Solar Thermal Program: The 10 MW rated Solar Two power tower achieved an instantaneous power production of 11 MW and demonstrated power production at night using stored molten salt (solar-on-demand) capability.

Year	Milestone Type	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	Description
				ACCOMPLISHED
1997	Technology Characteristic Milestones	$100	$2,100	Solar Thermal Program: With assistance from DOE's O&M cost-reduction program, the ten year old SEGS trough plant achieved higher efficiency and greater electricity output than when new.
1998	Other Milestones	$0	$9,000	Solar Thermal Program: Designed, constructed, and installed 2 technology validation 25 kW dis/engine systems at utility/field test sites in the U.S. Southwest.
		$0	$2,400	Solar Thermal Program: Designed, constructed, and installed four mass producible heliostats - two in a utility environment, and two at laboratory testing sites to evaluate performance variations and a variety of wind loads.
		$0	$25,000	Solar Thermal Program: Solar Two completed 100 hour acceptance test; produced sun-generated power around the clock for 153 hours (6 days); and produced over 1500 Mwh over a 30-day period.
				PLANNED
1999	Technology Characteristic Milestones	$9,000	$0	Solar Thermal Program: 750 hours of reliable operation for a distributed CSP system.
2000	Other Milestones	$0	$0	Solar Thermal Program: Complete Solar Two pilot power tower project.
	Technology Characteristic Milestones	$7,200	$0	Solar Thermal Program: Achieve 1000 hours mean time between failure (MTBF) for dish/engine systems installed at utility/field/reservation test sites in the U.S. Southwest.
2001		$4,700	$0	Solar Thermal Program: Achieve 17% annual solar-to-electric efficiency in distributed systems and demonstrated technology capable of 13% in dispatchable systems.
		$6,100	$0	Solar Thermal Program: Achieve 80% availability over 6 months for distributed utility field validation unit.
2002	Market Penetration Milestones	$0	$0	Solar Thermal Program: In cooperation with developer and/or user complete installation of the first MW of dish/engine systems for field validation in a distributed utility application.
	Technology Characteristic Milestones	$14,400	$0	Solar Thermal Program: Achieve 2000 hours MTBF for 5 dish/engine systems in field reliability testing

		PLANNED		
2003	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$12,300** Actual Cost (000 $'s): **$0**	Solar Thermal Program: Achieve 18% annual solar-to-electric efficiency in distributed systems and demonstrate technology capable of 15% in dispatchable systems.
		Estimated Cost (000 $'s): **$5,100** Actual Cost (000 $'s): **$0**	Solar Thermal Program: Validate subsystem technology capable of $.04/kWh energy costs in high-temperature dispatchable systems.
2004		Estimated Cost (000 $'s): **$18,000** Actual Cost (000 $'s): **$0**	Solar Thermal Program: Achieve 4000 hours MTBF for 5 dish/engine systems in unattended operation - this level of reliability will give distributed power purchasers the confidence they need for significant sales, both domestically and internationally.
		Estimated Cost (000 $'s): **$13,200** Actual Cost (000 $'s): **$0**	Solar Thermal Program: Reduce projected installed costs below $3,000/kW for dispatchable CSP systems.

OPT's Wind Energy R&D (FY99 Appropriation $ million, FY2000 Request $42.6 million)

Through a coordinated research effort with the industry and utilities, establish wind energy as a regionally diversified, cost-effective power generating technology for U.S. companies competing in domestic and international markets. Strategic thrusts include applied research to improve the fundamental understanding of wind energy physics, technology development with industry to investigate new concepts and attract new players to the industry, and cooperative research and testing to address near term problems, evaluate fiel performance of turbines, and support certification testing.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of 1995 $'s)				.04					.31	.52	.99	1.76
Carbon Equivalent Emissions Displaced (MMTCe)				.39					2.81	3.52	7.32	10.05
Total Primary Energy Displaced (Trillion Btu)				20.28					147.36	207.03	402.44	612.88

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)	28.60	32.50	43.50	42.60	41.00	40.00	38.00	38.00	42.90	42.90	42.90	42.90
Research (%)		50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Development (%)		50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Deployment (%)		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Partner Financial Investment (Millions of $'s)	4.00	8.00	12.00	12.00	12.00	12.00	12.00	12.00	7.00	7.00	7.00	7.00
Partner Non-Financial Investment (Millions of $'s)	2.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	1.00	1.00	1.00	1.00
Partners (Number)	6.00	8.00	10.00	12.00	12.00	12.00	12.00	4.00	10.00	10.00	10.00	10.00

1997 Other Milestones

ACCOMPLISHED

Year	Estimated Cost (000 $'s)	Actual Cost (000 $'s)	Accomplished
1997	$6,000	$9,300	Wind Energy R&D Program: Conducted core research studies and completed installation of the Advanced Turbine Test Facility at the National Wind Test Center.
		$4,000	Wind Energy R&D Program: Initiated 2 cost shared partnerships to develop next generation wind turbines.
	$5,000	$2,000	Wind Energy R&D Program: Selected 5 utilities to host cost shared wind turbine test and evaluation projects.
1998	$5,000	$2,000	Wind Energy R&D Program: Completed initial round of research tests and data analysis on wind/hybrid system for village application.
	$0	$2,000	Wind Energy R&D Program: National Wind Test Center established as test center for collection of turbine certification data.

Year	Milestone Type	PLANNED		
1996	Other Milestones	Estimated Cost (000 $'s): **$2,000** Actual Cost (000 $'s):		Wind Energy R&D Program: Complete negotiation of next generation contracts
		Estimated Cost (000 $'s): **$1,500** Actual Cost (000 $'s):		Wind Energy R&D Program: Initiate construction of 2nd project (GMP)
1999	Market Penetration Milestones	Estimated Cost (000 $'s): **$2,000** Actual Cost (000 $'s): **$0**		Wind Energy R&D Program: Over 20 MW of cost-shared projects installed.
2000	Technology Characteristic Milestones	Estimated Cost (000 $'s): **$7,000** Actual Cost (000 $'s):		Wind Energy R&D Program: Complete design of next generation turbine prototypes.
2001		Estimated Cost (000 $'s): **$15,000** Actual Cost (000 $'s):		Wind Energy R&D Program: Complete testing of next generation prototypes.
2002		Estimated Cost (000 $'s): **$20,000** Actual Cost (000 $'s): **$0**		Wind Energy R&D Program: Advanced wind turbine technology available capable of 2 ½ cents per kWh in 15 mph regions.
2004	Market Penetration Milestones	Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Wind Energy R&D Program: Three U.S. companies competing in world wind market.
2005		Estimated Cost (000 $'s): **$0** Actual Cost (000 $'s): **$0**		Wind Energy R&D Program: 25 percent of world wind market secured by U.S. industry.

Office of Transportation Technologies (OTT)

OTT's Advanced Automotive Technologies (FY99 Appropriation $ million, FY2000 Request $154.4 million)

In partnership with automobile manufacturers, automobile suppliers, electronics firms and material suppliers, the Advanced Automotive Technologies Program will conduct basic and applied research and develop technologies that will reduce weight, improve the efficiency of automotive components for gasoline and alternative fuel vehicles, and integrate controls and components to achieve the following: 1) by the year 1998 will have enabled the achievement of 50 miles per gallon in a prototype six-passenger sedan; 2) by 1999 will have developed technologies that enable compressed natural gas fueled vehicles to achieve full range and performance as comparable conventional vehicles; 3) by 2003 will have developed battery technologies which will render full-range electric automobiles commercially viable; 4) by 2008 will have developed automotive technologies that enable the achievement of 80 miles per gallon in a six-passenger sedan that could be successfully marketed; 5) by 2008 will have enabled the use of ethanol in a demonstration six-passenger sedan that achieves 80 miles per gallon; and 6) by 2015 will have developed automotive technologies that use non-petroleum based fuels and achieve zero emissions while obtaining 100 miles per gallon in lightweight vehicles that could be successfully marketed. By 2010, these achievements will result in 0.283 MBPD of oil displaced, $5 billion in energy savings and 3.3 MMTCE reduced, resulting in less urban air pollution and less dependence on foreign oil. By 2010, advanced automotive technologies will have entered and captured nearly 60% of the U.S. automobile market.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Total Primary Energy Displaced (Trillion Btu)			.00	.00	.00	.00	3.03	28.12	32.00	637.75	1214.91	1589.99
Carbon Equivalent Emissions Displaced (MMTons)			.00	.00	.00	-.01	-.03	.31	1.11	10.00	20.16	27.19
Energy Costs or Savings (Billions of $'s)				.00		.00	.01	.23	.73	6.11	12.03	15.71

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)												
Research (%)												
Development (%)												
Deployment (%)												
Partner Financial Investment (Millions of $'s)												
Partner Non-Financial Investment (Millions of $'s)												
Partners (Number)												

1997 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Advanced Automotive Technologies Program: Completed testing of four baseline prototype high power battery cells and selected two baseline technologies for development of 50-volt prototype modules.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Advanced Automotive Technologies Program: Completed preliminary power electronics building block modules (PEBB) for use in motor invertors aimed at achieving 50% reduction in cost, weight, and volume.

1997	Other Milestones	**ACCOMPLISHED**	
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Demonstrated a 50 kW fuel-flexible fuel processor for fuel cell applications operating at high efficiency and capable of reforming conventional and alternative transportation fuel (i.e., gasoline, ethanol, etc.)
1998		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Completed development and testing of 50 mpg series hybrid propulsion system for a mid-size vehicle.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Completed PEBB basic R&D technology and validated performance again PNGV targets, redirected efforts to integrate PEBB component technologies to develop an Automotive Integrated Power Module (AIPM).
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Completed laboratory validation of 50-kW hydrogen-fueled proton-exchange-membrane (PEM) fuel cell brassboard and 30-kW methanol-fuel PEM fuel cell brassboard.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Conducted the world's first demonstration of a PEM fuel cell system running on gasoline.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Fabricated first generation 50-volt nickel metal hydride power models and initiated life cycle testing.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Initiated extensive laboratory testing of lithium-polymer electric vehicle batteries (modules and cells) which will provide 3 to 4 times the range and significantly greater performance and life, compared to conventional lead-acid batteries.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Launched the Cooperative Automotive Research for Advanced Technology (CARAT) program and awarded approximately 26 cooperative agreements in 18 technical areas.
		PLANNED	
1999		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Initiate life cycle testing of advanced electric vehicle lithium-polymer batteries and assess performance against USABC long-term battery of goal of 1,000 cycles.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Complete development and testing of 50 mpg parallel hybrid propulsion systems for mid-size vehicles and continue technology development and integration activities aimed at 80 mpg vehicles.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Demonstrate a high-volume manufacturing process for lightweight, low-cost bipolar plates and membrane-electrode assemblies.

Year	Milestone Type	Cost	PLANNED
2000	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Advanced technologies that enable development of pre-production automobiles with three times the fuel economy of today's conventional automobiles.
	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Complete extended testing of USABC long-term lithium-polyner batteries to determine life and safety under accident conditions.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Complete testing of baseline, prototype, 50-volt high power lithium-ion modules. Select one or two of the baseline technologies for development of 400-volt battery aimed at satisfying the PNGV high power energy storage requirements of hybrid vehicles.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Demonstrate a fuel-flexible 50-kW fuel processor integrated with advanced shift reactor, fuel vaporizer and CO clean-up.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Demonstrate a reformer capable 50-kW fuel cell stack system integrated with sensors, controls, and thermal and air management systems.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: For medium and heavy trucks, initiate cooperative agreements with two development teams. During the first year, demonstrate an 80% improvement in fuel efficiency, 95% reduction in particulate emissions, and a 30% reduction in oxides of nitrogen emissions compared to current production in a test vehicle that will be the basis for a production feasible design development over the following 3 years program.
	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	PNGV: Three domestic automakers to incorporate the most promising PNGV technologies in concept vehicles with up to three times average fuel economy of 1993 Taurus, Lumina and Condorde models.
2002		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Complete modifications and initial field test of light trucks with engines to demonstrate a 50 percent increase in mpg and compliance with 2004 emissions standards.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Test and evaluate a fuel-flexible 50kW integrated power system (emissions, start-up, transient response, and efficiency).
2003		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Complete core performance tests of 1st generation lithium-polymer batteries with low-cost components, and transfer the low-cost batteries to the developers for incorporation in electric vehicle platforms.
2004	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Advanced technologies that enable commercial production of pickup trucks that achieve at least a 35% efficiency improvement relative to current gasoline fueled trucks.

			PLANNED
2004	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Complete development of a fuel-flexible 50kW integrated system meeting all year 2004 technical targets.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Complete test and evaluation of the integrated, 50 kW (vehicle-size) fuel cell propulsion system that includes a fuel-flexible onboard fuel processor and demonstrates a total system efficiency of 40 percent at 25 percent peak power.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Demonstrate propulsion systems, advanced battery, high power electronic and accessory technologies, in a rolling test platform, capable of meeting PNGV goals.
2005	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Advanced Automotive Technologies Program: Light vehicle market penetration in light vehicles: SDI: 5.4% Advanced Diesel: 12.2% Electric: 0.9% Hybrid: 2.5%

OTT's Biofuels (FY99 Appropriation $ million, FY2000 Request $47.441 million)

By 2003, in collaboration with the biotechnology industry and providers of alternative fuels, the Biomass Ethanol Program will continue to undertake research, development and deployment activities in order to: a) demonstrate large scale conversion of various lignocellulosic wastes to ethanol; b) lay the groundwork for the establishment of technologies for converting energy crops such as switchgrass to ethanol; c) demonstrate biomass crop supply systems and incrementally improve species for use in conversion technology development. These will help meet the long-term objective of displacing up to 700,000 barrels of oil per day and reducing the emission of carbon (as CO_2) by 26 million tons per year by 2020. This will meet the nation's need for reducing our dependence on foreign oil and decreasing greenhouse gas emissions.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Total Primary Energy Displaced (Trillion Btu)				.01	.08	2.79	5.39	10.46	54.16	359.78	787.74	1000.64
Energy Costs or Savings (Billions of $'s)					.00	.00	.00	.00	-.01	.00	.07	.07
Carbon Equivalent Emissions Displaced (MMTCe)				.00	.01	.05	.10	.20	1.02	6.77	14.83	18.84

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)		30.68	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Research (%)		.45	.45	.45	.45	.45	.45	.45	.45	.45	.45	.45
Development (%)		.35	.35	.35	.35	.35	.35	.35	.35	.35	.35	.35
Deployment (%)		.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20
Partner Financial Investment (Millions of $'s)	8.00	7.00	7.00	7.00	8.00	8.00	8.00	8.00	9.00	10.00	10.00	10.00
Partner Non-Financial Investment (Millions of $'s)	2.00	3.00	3.00	3.00	4.00	4.00	4.00	4.00	5.00	6.00	6.00	6.00
Partners (Number)		6.00	6.00	6.00	7.00	7.00	7.00	7.00	8.00	9.00	9.00	9.00

1998 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization R&D Program: Collaborated with biomass power program to initiate a large scale switchgrass planting.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization R&D Program: Completed separate competitive solicitations to develop advanced enzymes, to produce the next generation fermentation organisms, and to conduct bioethanol feasibility studies at corn-to-ethanol plants.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization R&D Program: Completed bench-scale development and formed partnership for converting softwoods to ethanol using dilute acid hydrolysis.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization R&D Program: Completed bench- and pilot-scale testing of converting sugar cane bagasse to ethanol.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization R&D Program: Expanded switchgrass breeding activities and initiated a 20-acre research test to validate the yield and cost of switchgrass production.

Year	Milestone type	PLANNED	
1998	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Completed bench scale testing of rice straw conversion to ethanol.
1999		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Completed a feasibility study of corn add-on facility for the conversion of cellulosic feedstocks.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Established partnership with timber industry, United States Forest Service, and local communities to evaluate environmental and social effects of watershed forest management to suppress forest fires through production of ethanol and electricity using forest thinning.
2000	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Establish partnerships with equipment manufacturers and other groups for R&D of harvesting, handling, and storage alternatives for switchgrass.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: In FY 2000, startup of a demonstration facility that converts low-cost waste biomass into ethanol at a production cost of $1.13 (1996 dollars) compared to $1.22 in 1996.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Select partner to demonstrate enzymatic conversion of cellulose to ethanol as an add-on to corn-to-ethanol factility.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Complete bench scale process for the enzymatic conversion of cellulose to ethanol and establish economic feasibility (on-site Trichoderma reesei production).
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Successfully demonstrate conversion of agricultural wastes to ethanol at a small commercial scale using a genetically engineered fermentative microorganism.
2001	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Complete evaluation of pilot scale countercurrent pretreatment reactor with industry partner.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Pilot demonstration of ethanol production with wastes.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Select enzyme manufacturing partner to develop advanced cellulase enzyme systems.

Year	Milestone type	PLANNED	
2001	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Start-up municipal solid waste-to-ethanol plant.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Complete pilot scale R&D of rice straw conversion to ethanol and electricity.
2002	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Begin demonstration phase of Gridley project.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Begin development of enzymatic conversion technologies with appropriate industry partners.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: In partnership with USDA, complete development of integrated equilibrium economics model for energy crops.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Complete pilot scale R&D of softwoods' conversion to ethanol and electricity.
2003	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Begin commercial development of softwoods to ethanol and electricity.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Complete pilot testing of cellulose conversion technologies in cooperation with corn ethanol industry.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Complete pilot testing of countercurrent pretreatment reactor with industry.
2004		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Complete pilot testing of advanced fermentation organism development with industry.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Conduct pilot testing with ethanol partner for energy crop conversion.

		PLANNED
2004 Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Demonstrate 3-fold improvement (from 1998 base) of cellulase enzyme activity.
2005 Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Produce 600 million gallons of cellulosic ethanol.
Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Begin small commercial scale demonstration of enzymatic process in collaboration with a corn-ethanol producer.
	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: In partnership with industry, demonstrate technologies capable of economically producing ethanol from energy crops, such as switchgrass.
Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization R&D Program: Demonstrate first-of-a-kind switchgrass conversion to ethanol at a production plant.

OTT's Fuels Utilization (FY99 Appropriation $0 million, FY2000 Request $23.5 million)

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Total Primary Energy Displaced (Trillion Btu)												
Energy Costs or Savings (Billions of $'s)												
Carbon Equivalent Emissions Displaced (MMTCe)												

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)												
Research (%)												
Development (%)												
Deployment (%)												
Partner Financial Investment (Millions of $'s)												
Partner Non-Financial Investment (Millions of $'s)												
Partners (Number)												

1997 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Conceptualized the systems approach to the non-engine energy losses in heavy vehicles; this was not an approach previously considered at DOE and not even widely recognized in the heavy vehicle industry itself.

1998

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Completed development of a lower cost, lighter weight natural gas cylinder for onboard storage.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Completed phases I testing of advanced petroleum-based fuels.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Completeed initial analysis of vehicle dynamics to determine initial program direction in planning with industry.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Developed a natural gas light duty vehicle to meet ultra-low emission vehicle (ULEV) standards, with a range of 300 miles, and a unique integrated storage system.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Operated a diesel engine in flexible-fuel mode.

PLANNED

1999

Other Milestones

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Begin development of a small scale reformer to produce hydrogen at 5kg/day in order to fuel small fleets in a cost effective manner.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Complete development of a prototype fuel injection system for DME for automotive application.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Complete test and evaluation of an advanced compression ignition direct injection (CIDI) engine, representative of PNGV size, with conventional fuels blended with alternative fuels to reduce NOX and particulate emissions.

Technology Characteristic Milestones

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Demonstrate 40% efficiency in heavy duty engine operating on natural gas.

2000

Other Milestones

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Begin development of materials and lubricants to meet automotive and light truck durability and performance requirement while operating on DME.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Complete development of small scale hydrogen production for fuel cell vehicles.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Complete efficiency and emissions evaluation of natural gas in direct injection engines.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Complete initial screening of fuels for fuel cells.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Develop techniques for sampling and measuring fine particulate matter.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Initiate assessment of the impacts of fuel changes on fuel production, infrastructure, and environment.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Fuels Utilization Program: Initiate assessment of the impacts of fuel changes on fuel production, infrastructure, and environment.

Year	Category	Cost	PLANNED
2000	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization Program: Select advanced liquid fuels for PNGV and other 21st Century concept vehicles.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	PNGV: Begin evaluation of DME in PNGV and light struck applications.
2001		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization Program: Based on accumulated data base, start final evaluation and engine optimization of advanced engines operating on new fuel formulations.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization Program: Complete NGV2 and other appropriate industry standards tests of newly developed low-cost LNG storage systems and CNG onboard storage tanks.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	PNGV: Assess infrastructure requirements and cost impact for producing optimum natural gas or natural gas derived fuels for direct injection and/or fuel cell engines in support of PNGV and light truck programs.
2002		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization Program: Select advanced fuels for fuel cell vehicle.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization Program: Demonstrate heavy duty operation at 45% efficiency operating on natural gas.
2003	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization Program: Design and demonstrate a liquefied compressed natural gas (LCNG) station that can fuel any type of natural gas vehicle with a 50% reduction in price.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization Program: Design and demonstrate a natural gas reformer for use in an LCNG station.
2004	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization Program: Demonstrate operation of a heavy duty Class 8 truck that operates on natural gas and is fully competitive with its diesel fuel counterpart in cost and performance.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Fuels Utilization Program: Design and demonstrate a fully integrated compressed natural gas vehicle system in a medium duty truck, incorporating high efficiency engine and low-cost fueling system.

2004 Other Milestones

PLANNED

Estimated Cost (000 $'s):

Actual Cost (000 $'s):

Fuels Utilization Program: Develop a cost-effective natural gas vehicle system for typical Class 3-6 inner cuty trucks and Class 7-8 intra city applications.

OTT's Heavy Duty Vehicle Technologies (FY99 Appropriation $ million, FY2000 Request $4 million)

1. Develop by 2002 the diesel engine enabling technologies to support large-scale industry dieselization of light trucks, acheiving a 50% fuel economy improvement over gasoline fueled trucks;

2. Develop by 2004 the enabling technology for a Class 7-8 truck with a fuel efficiency of 10 miles per gallon (at 65 miles per hour) which will meet prevailing emissions standards, using either diesel or a liquid alternative fuel;

3. Develop by 2006 diesel engines with fuel flexibility and a thermal efficiency of 55% using a dedicated gaseous fuel.

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Total Primary Energy Displaced (Trillion Btu)		.00	1.99	7.47	13.31	20.08	31.25	46.19	64.85	205.28	313.14	396.26
Carbon Equivalent Emissions Displaced (MMTons)			.05	.18	.30	.44	.66	.94	1.29	3.87	5.87	7.48
Energy Costs or Savings (Billions of $'s)			.02	.07	.12	.18	.31	.49	.73	2.75	4.17	5.05

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)		1.70	25.20	26.00	35.00	40.00	40.00		40.00	25.00	22.00	15.00
Research (%)		.30	.25	.25	.20	.20	.20	.20	.30	.35	.50	.55
Development (%)		.40	.45	.55	.60	.60	.55	.55	.50	.50	.40	.35
Deployment (%)		.30	.30	.20	.20	.20	.25	.25	.20	.15	.10	.10
Partner Financial Investment (Millions of $'s)	2.00	3.00	3.50	4.00	4.00	9.00						
Partner Non-Financial Investment (Millions of $'s)		5.00	6.00	10.00	12.00	15.00						
Partners (Number)		24.00	27.00	27.00	28.00	28.00						

1997 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Heavy Duty Vehicle Technologies Program: Achieved reliable compression ignition in a heavy duty, high efficiency, direct injected natural gas engine.

1998

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Heavy Duty Vehicle Technologies Program: Successfully operated a heavy duty engine on natural gas with direct injection.

PLANNED

1999

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Heavy Duty Vehicle Technologies Program: Complete development of a prototype fuel injection system for DME for automotive application.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Heavy Duty Vehicle Technologies Program: Complete systematic program plan identifying the top three technical areas for greatest impact in heavy vehicle systems (non-engine) energy use. Assemble teams at national laboratories and universities to initiate the program plans.

2000

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Heavy Duty Vehicle Technologies Program: Validate aero drag simulation models and initiate predictive reduced drag, higher efficiency vehicular design modifications.

Year	Milestone type	PLANNED	
2001	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Heavy Duty Vehicle Technologies Program: Validate manufacturing cost-effectiveness of new designs.
2003		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Heavy Duty Vehicle Technologies Program: Characterize and qualify concepts such as circulation control devices for increased operational efficiency and greater stability of heavy vehicles.
2005	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Heavy Duty Vehicle Technologies Program: Sell over 20,000 advanced diesel heavy vehicles.

OTT's Technology Deployment (FY99 Appropriation $ million, FY2000 Request $17 million)

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of $'s)			.06	.13	.23	.35	.49	.60	.71	.85	.83	.70
Total Primary Energy Displaced (Trillion Btu)				.00					.00	.00	.00	.00
Carbon Equivalent Emissions Displaced (MMTons)			.17	.27	.43	.62	.83	1.04	1.24	1.82	1.98	1.94

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)												
Research (%)												
Development (%)												
Deployment (%)												
Partner Financial Investment (Millions of $'s)												
Partner Non-Financial Investment (Millions of $'s)												
Partners (Number)												

1997 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Clean Cities: Launched the clean Cities program in 1993 and added 25 participants in the subsequent 18 months, bringing national attention to the role that local communities can play in deploying alternative fuel vehicles.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Conducted emissions and performance testing on thousands of light duty alternative fuel vehicles in federal and private fleets, yielding the world's largest database of scientific information on alternative fuel vehicles.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Developed and implemented the EV American testing program, in partnership with industry, that led to the first comprehensive evaluation standards for electric vehicles.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Developed and published regulations implementing the State and fuel provider alternative fuel vehicles acquisition mandates under the Energy Policy Act of 1992.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Developed and published, in coordination with the Department's Office of Policy, a comprehensive report on the feasibility of achieving the Energy Policy Act goals.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Developed and published a comprehensive report on the potential for replacement fuels to meet the goals of the Energy Policy Act.

1997	Other Milestones	ACCOMPLISHED	
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Exposed thousands of college students to advanced transportation technologies, over 50% who are now working in the automotive industry putting their experience to work.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: In partnership with other Federal agencies, facilitated the acquisition and deployment of over 30,000 alternative fuel vehicles into the Federal fleet.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Provided over $8 million in financial assistance grants to Clean cities through the State Energy Program Special Projects, leverage over $30 million in non-Federal investment for alternative fuel projects.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Sponsored student competitions for methanol, natural gas, propane, and hybrid vehicles that demonstrated innovative technologies to meet energy and environmental goals.
1998		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Clean Cities: Added electric and hybrid vehicle data and information products to the Alternative Fuels Data Center and disseminated the information through Clean Cities.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Clean Cities: Demonstrated reliability and performance by traveling 600 miles from the General Motors Proving Grounds in Michigan to Washington, DC. Challenge participants were featured in the National Clean Cities Conference.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Clean Cities: Expanded Clean Cities programs to 66 participating communities and focused efforts on assisting implementation of local plans for alternative fuel market development.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Clean Cities: Launched the ethanol infrastructure development program in two Clean Cities
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Clean Cities: Strengthened infrastructure corridor program, through the State and Clean Cities, that encourage refueling development and alternative fuel use.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	FutureCar: Achieved 75 mpg in two FutureCar vehicles during the on-road fuel economy event.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	FutureCar: Demonstrated industry's commitment to the FutureCar competition through USCAR's donation of 10 new vehicles and substantial seed and award money for the participating universities.

1998 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Continued implementation of EPACT fleet requirements and undertook a rulemaking to consider expanding requirements to private and local fleets.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Demonstrated improved cold start capability, fuel economy and emissions of dedicated E-85 vehicles.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Facilitated the acquisition of over 4,000 alternative fuel vehicles by the Federal agencies.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Initiated the Ethanol Challenge which included 14 universities.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Initiated an electric vehicle loaner program for Federal agencies to provide additional opportunities for them to evaluate and acquire electric vehicles.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Introduced fuel cell technology into the FutureCar competition at two universities.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Moved the certification of training program to the private sector.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Started the first year of field test/evaluation of electric vehicles using first generation advanced batteries developed through the cooperative agreement with the U.S. Advanced Battery Consortium.

1999 Market Penetration Milestones

PLANNED

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Continue EPACT fleet programs, adding 8,000 AFVs to the Federal fleet and completing the rulemaking on private and local fleets.

Other Milestones

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Continued enforcement of EPACT fleet programs and continue the rulemaking process on private and local fleets.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Technology Deployment Program: Demonstrate dramatic light weighting and mass reduction in FutureCar vehicles to achieve higher fuel economy.

		PLANNED	
1999	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Demonstrate improved energy efficiency and reduced emissions from dedicated E-85 vehicles in the second year of the Ethanol Challenge.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Determine, through public comment and rulemaking, how to modify the EPACT replacement fuel goal, and design a program to promote the maximum practicable use of replacement fuels.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Expand the Clean Cities scope to include emphasis on fuel efficient vehicles, and expand grants to States and Clean Cities to demonstrate vehicles with significantly improved duel economy. Link and solidify Clean Cities infrastructure and corridor investments launched in 1996 through 1998.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Improve the value of the Fuel Economy Guide and other information products, as a means to encourage the use of fuel efficient vehicles.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Introduce new direct injection (DI) engine technologies into the university competition.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Demonstrate 65 mpg fuel efficiency on the combined driving cycle on mid-sized sedans in advanced technology competitions.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Demonstrate two on-the-road fuel cell-powered FutureCar vehicles.
2000	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Clean Cities: Complete the final year of light duty electric vehicle test and evaluation, compile and report results through the Alternative Fuel Data Center and Clean Cities information network.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Clean Cities: Create Clean Cities Buyers Clubs to help consumers and fleets obtain alternative fuel vehicles quickly and at lower cost.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Clean Cities: Expand Clean Cities educational materials that focus on alternative fuels and advanced fuel efficient technologies.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Clean Cities: Expand the number of Clean Cities participating in the ethanol infrastructure development program.

Year	Milestone Type	Cost	PLANNED
2000	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Clean Cities: Strengthen Clean Cities focus on proven niche markets, leading 100% of alternative fuels in several niche markets in selected Clean Cities.
	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Support the annual acquisition of 12,000 alternative fuel vehicles in the Federal fleet.
	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Continue implementation and enforcement of existing EPACT alternative fuel vehicle programs. Complete and publish a final determination for the expansion of vehicle requirements to private and local government fleets.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: During the second year of medium and heavy duty hybrid test and evaluation program, initiate cost-shared procurement and placement of vehicles with Federal and industry partners.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Open FutureCar Challenge participation to 12 new universities.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Demonstrate 70 mpg in FutureCar competition vehicles.
2001	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Clean Cities: Continue Clean Cities corridor and infrastructure efforts to strengthen and expand availability of refueling infrastructure. Expand the number of Clean Cities that achieve 100% penetration of alternative fuel vehicles in niche markets. Create Clean Cities "Early Adopter" Club for advanced technology vehicles.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Demonstrate 80 mpg in multiple FutureCar competition vehicles.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Launch phased test and evaluation programs for light duty hybrid vehicles, fuel cell vehicles, and medium/heavy duty natural gas vehicles as they become available from technology development programs.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Prepare and submit to Congress analysis and recommendations for additional programs and policies that may be needed to meet the EPACT replacement fuel goals.
2004	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Through EPACT fleet program implementation, increase the number of alternative fuel vehicles in fleets to as many as 3 million vehicles.

Year	Milestone		PLANNED
2004	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Alternative fuel vehicles will account for 40-50% of the transit bus orders (30% in 1998); 10-20% of school bus orders (<1% in 1998); and 10-20% of the covered light duty fleet orders with spillover into the medium duty market (<1% in 1998).
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Clean Cities will grow from 66 to over 100 participants but, more importantly, 15% of the Cities will attain a 100% AFV goal for a specific market niche (e.g., taxis, shuttles, school buses, etc.).
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Cost-shared infrastructure/corridor development will yield 10 times the number of E85 refueling stations (<50 in 1998), 5 times the number of EV recharging stations (500 in 1998), and 5 times the number of natural gas stations available in 1998 (1,400 in 1998).
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: In selected metropolitan areas, alternative fuel vehicles will be commonplace and supported by extensive refueling infrastructure.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: The blend market for renewable fuels will be 50% larger (1 billion gallons annually in 1998).
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Vehicle competitions will have demonstrated 60 and 80 mpg cars and generated hundreds of highly trained automotive engineers.
2005	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Technology Deployment Program: Natural gas vehicle market penetration in light vehicles is 2.2%.

OTT's Transportation Materials Technologies (FY99 Appropriation $ million, FY2000 Request $33 million)

Metrics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Total Primary Energy Displaced (Trillion Btu)			.00	.00	.00	.00	.04	.29	.76	11.87	31.69	49.66
Carbon Equivalent Emissions Displaced (MMTons)				.00		.00	.00	.01	.02	.25	.66	1.03
Energy Costs or Savings (Billions of $'s)				.00			.00	.01	.01	.16	.39	.58

Resources	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)												
Research (%)												
Development (%)												
Deployment (%)												
Partner Financial Investment (Millions of $'s)												
Partner Non-Financial Investment (Millions of $'s)												
Partners (Number)												

1997 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Developed an intelligent system for induction heating and hardening that has been applied by industry in producing drive train components with precision five times better than industry standards.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Developed the technology of metal compression forming for monolithic aluminum alloys for vehicle applications on all platforms that enables increased use of aluminum with a 40% reduction in cost from prior aluminum cost, achieving cost parity with cast iron while gaining a 50% weight reduction.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Developed life prediction methodology of in-situ toughened silicon nitride to the point that accurate results can be achieved for most fracture models.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Successfully completed a 35 mph crash test of a vehicle front end constructed of composite materials which were 33% lighter than the steel parts they replaced.

1998

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Completed transition from focus on gas turbine for CIDI engines, fuel cells, and power electronics for hybrid vehicle applications.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Demonstrated aluminum sheet processing technology which is 50% lower cost compared to the cost of conventional ingot-to-sheet processing technology.

1998 Other Milestones

ACCOMPLISHED

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Demonstrated ultra-large casting technology for large aluminum components applicable to all vehicle platforms which enable reduction in heavy trucks by 1,250 pounds (5%) through substitutions of aluminum for conventional materials.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Established facilities for evaluating material performance under high thermal shock and cyclic oxidation of thermal barrier coatings; and added radiography, temography, and temperature measurement inside running engine to neutron-based characterization capabilities.

1999

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Successfully completed 500-hour thermal fatigue durability testing of thick thermal barrier coatings for piston-crown insulation proving the concept to reduce heat loss through the pistons and allowing lower cost piston materials.

PLANNED

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Complete development of the process for casting ultra large vehicular components; cast prototypes for laboratory testing and evaluation by OEMs; field test qualified components under service conditions.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Demonstrate an intelligent grinding process for ceramic engine components, and demonstrate manufacturing of products such as engine valves and fuel injector components.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Demonstrate low cost casting methods to produce structural light metal casting for automotive applications.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Extend the successful development of metal compression forming for solid solution and precipitation hardenable aluminum alloys to metal matrix composites and magnesium alloys. Produce prototype components for testing and evaluation by OEMs.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Initiate fabrication and testing of advanced carbon foam heat sinks for thermal management of power electronics that offer an increase in effective heat transfer by up to 4 orders of magnitude, a factor of 10 reduction for the heat exchanger, and 20 to 35 percent improvement in cost necessary to meet the target of $7.00 per kilowatt for the power electronics system.

2000 Technology Characteristic Milestones

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Develop cost-effective technologies to manufacture thick thermal barrier coated pistons for the LE-55 engine to enable use of lower cost alloys for pistons; demonstrate 2,000 hours durability.

Other Milestones

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Complete fabrication and testing of high-temperature. Low-loss capacitors with 10-times volume reduction for power electronics.

Estimated Cost (000 $'s):
Actual Cost (000 $'s):

Lightweight Materials: Demonstrate low-cost, high-volume manufacturing processes for composite fuel cell bipolar plates with standard flowfield design to meet $10.kW cost target.

2000	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Lightweight Materials: Develop and validate materials technologies that, when implemented, will enable a reduction in automobile body and chassis weight by 50% with respect to a 1994 baseline automobile at 1.5 times the cost of the baseline, and a reduction of the weight of the unloaded heavy duty tractor-trailer units by 20%, while maintaining safety, reliability, and recyclability.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):		Lightweight Materials: In conjunction with industry, define and test the design, methodological, materials, process, and forming approaches required to cost effetively achieve total heavy vehicle weight reduction of 5,000 pounds (over 20%); validate the maintenance of safety and vehicular performance requirements.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):		Lightweight Materials: Provide enabling materials for higher efficiency, low-emission, advanced propulsion systems including advanced diesel engines, fuel cells, and power electronics with identification and functional proof of concept of the advanced materials and manufacturing technologies by 2000 and demonstration of cost competitiveness by 2004.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):		Lightweight Materials: Validate lightweight technologies to enable a 50% reduction in automobile body and chassis weight.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Lightweight Materials: Demonstrate technologies that enable a high modulus (>33 Mpsi) reinforcing fiber that will sell for less than $5.00 per pound for use in advanced composite automotive structures with comparable costs to steel and 60% weight savings for applicable automotive parts.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):		Lightweight Materials: Develop material for regenerative exhaust filter to reduce diesel engine particulate emissions to less than 0.025 grams per mile.
2001	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Lightweight Materials: Complete testing of continuous sintering methods for diesel engine components.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):		Lightweight Materials: Validate crash energy absorption model for carbon fiber composite-intensive automobiles.
2003		Estimated Cost (000 $'s): Actual Cost (000 $'s):		Lightweight Materials: Develop high-volume manufacturing procedures for nonthermal plasma catalyst materials and microwave regenerated diesel exhaust filters to reduce diesel engine NOX and particulate emissions.
	Technology Characteristic Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Lightweight Materials: Validate dies cast magnesium alloy automobile components costing less than $1.65 per pound with satisfactory performance at high temperature and offering 33% weight savings relative to aluminum.
2004	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):		Lightweight Materials: Complete development of key materials components such as the ceramic capacitor for the integrated power electronics module and catalyst material for the integrated diesel exhaust system and deliver to automotive suppliers with the integrated systems.

PLANNED

		PLANNED	
2004	Other Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Lightweight Materials: Improve materials technology to enable a 50% reduction in the weight of automobile body and chassis components and a 40% reduction in the overall vehicle weight (PNGV target) while achieving cost competitiveness, and to enable a 30% reduction in weight of unloaded heavy duty tractor-trailer units.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Lightweight Materials: Validate lightweight technology to enable a 30% reduction in total heavy vehicle weight.
		Estimated Cost (000 $'s): Actual Cost (000 $'s):	Lightweight Materials: Validate through test and analysis lightweight technologies to enable a 50% reduction in automobile body and chassis weight with cost competitiveness.
2005	Market Penetration Milestones	Estimated Cost (000 $'s): Actual Cost (000 $'s):	Lightweight Materials: Market penetration throughout light vehicle market of lightweight technologies.

The Office of Energy Efficiency & Renewable Energy

GPRA2000 Metric Report

Office of Build Tech, State, and Comm Progs (BTS)

Resource

DOE Funding Level (Millions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration				$5.83	$5.83	$5.83	$5.83	$5.83	$5.83	$5.83	$5.83	$5.83
Community Partnerships Program				$31.40	$31.40	$31.40	$31.40	$31.40	$31.40	$31.40	$31.40	$31.40
Energy Star Program				$4.00	$4.00	$4.00	$4.00	$4.00	$2.00	$1.00	$1.00	$1.00
Equipment, Materials, and Tools				$49.30	$48.80	$46.70	$46.90	$48.40	$47.20	$43.10	$39.00	$25.70
Residential Buildings Integration				$13.04	$13.04	$13.04	$13.04	$13.04	$13.04	$13.04	$0.68	$0.68
State Energy Program		$30.25	$37.00	$37.00	$37.00	$37.00	$37.00	$37.00	$37.00	$37.00	$37.00	$37.00
Technology Roadmaps & Competitive R&D				$6.00	$6.00	$6.00	$6.00	$6.00	$6.00	$6.00	$6.00	$6.00
Weatherization Assistance Program		$124.85	$161.80	$154.10	$154.10	$182.00	$192.00	$202.00	$212.00	$212.00	$212.00	$212.00
BTS DOE Funding Level Total		$155.10	$198.80	$300.66	$300.16	$325.96	$336.16	$347.66	$354.46	$349.36	$332.90	$319.60

Research (%)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Community Partnerships Program	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Energy Star Program	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Equipment, Materials, and Tools	0%	0%	0%	45.00%	45.00%	40.00%	40.00%	40.00%	40.00%	45.00%	45.00%	40.00%
Residential Buildings Integration	0%	0%	0%	45.00%	55.00%	60.00%	60.00%	60.00%	60.00%	60.00%	0%	0%
State Energy Program	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Technology Roadmaps & Competitive R&D	0%	0%	0%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%
Weatherization Assistance Program	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Development (%)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration	0%	0%	0%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%
Community Partnerships Program	0%	0%	0%	9.00%	9.00%	9.00%	9.00%	9.00%	9.00%	9.00%	9.00%	9.00%
Energy Star Program	0%	0%	0%	30.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%
Equipment, Materials, and Tools	0%	0%	0%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%
Residential Buildings Integration	0%	0%	0%	55.00%	40.00%	35.00%	35.00%	35.00%	35.00%	35.00%	20.00%	20.00%
State Energy Program	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Technology Roadmaps & Competitive R&D	0%	0%	0%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%
Weatherization Assistance Program	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Deployment (%)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration	0%	0%	0%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%
Community Partnerships Program	0%	0%	0%	91.00%	91.00%	91.00%	91.00%	91.00%	91.00%	91.00%	91.00%	91.00%
Energy Star Program	0%	100.00%	100.00%	70.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%
Equipment, Materials, and Tools	0%	0%	0%	35.00%	35.00%	40.00%	40.00%	40.00%	40.00%	35.00%	35.00%	40.00%
Residential Buildings Integration	0%	0%	0%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	80.00%	80.00%
State Energy Program	0%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Technology Roadmaps & Competitive R&D	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Weatherization Assistance Program	0%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Partner Financial Investment (Millions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration	$210.00			$5.50	$5.50	$5.50	$5.50	$5.50	$5.50	$5.50	$5.50	$5.50
Community Partnerships Program				$1.44	$1.44	$1.44	$1.44	$1.44	$1.44	$1.44	$1.44	$1.44
Energy Star Program				$30.00	$30.00	$30.00	$30.00	$30.00	$30.00			
Equipment, Materials, and Tools				$17.80	$20.90	$68.90	$69.70	$70.10	$70.70	$19.40	$31.40	$50.40
Residential Buildings Integration	$8.00			$6.00	$8.00	$10.00	$12.00	$14.00	$16.00	$26.00		
State Energy Program	$116.00	$148.00	$148.00	$148.00	$148.00	$148.00	$148.00	$148.00	$148.00	$148.00	$148.00	$148.00
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program	$197.70	$197.70	$197.70	$197.70	$197.70	$197.70	$197.70	$197.70	$197.70	$197.70	$197.70	$197.70
BTS Partner Financial Investment Total	$531.70	$345.70	$345.70	$406.44	$411.54	$461.54	$464.34	$466.74	$469.34	$398.04	$384.04	$403.04

Partner Non-Financial Investment (Millions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration												
Community Partnerships Program				$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00
Energy Star Program				$2.70	$2.70	$2.70	$2.70	$2.70	$2.70			
Equipment, Materials, and Tools				$14.90	$19.90	$26.00	$41.00	$51.00	$76.00	$9.00	$14.00	$22.00
Residential Buildings Integration				$0.50	$0.75	$1.00	$1.25	$1.50	$1.75	$2.00		
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS Partner Non-Financial Investment Total				$19.10	$24.35	$30.70	$45.95	$56.20	$81.45	$12.00	$15.00	$23.00

Partners (Number)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration				30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Community Partnerships Program				254.00	304.00	354.00	404.00	404.00	504.00	754.00	4.00	4.00
Energy Star Program				75.00	100.00	125.00	150.00	175.00	200.00			
Equipment, Materials, and Tools				212.00	359.00	531.00	934.00	1,320.00	2,122.00	113.00	117.00	121.00
Residential Buildings Integration			124.00	90.00	100.00	105.00	110.00	115.00	120.00	125.00		
State Energy Program				55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program		806.00	806.00	806.00	806.00	806.00	806.00	806.00	806.00	806.00	806.00	806.00
BTS Partners Total		806.00	930.00	1,522.00	1,754.00	2,006.00	2,489.00	2,905.00	3,837.00	1,883.00	1,012.00	1,016.00

Energy

Total Primary Energy Displaced (Trillion Btu)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration				9.54	13.22	24.36	35.21	50.68	69.69	207.26	386.28	535.36
Community Partnerships Program				7.81	18.56	34.73	54.90	75.76	97.16	224.66	355.60	434.35
Energy Star Program				2.82	7.49	15.85	26.41	37.84	50.12	106.44	161.45	210.29
Equipment, Materials, and Tools				35.69	58.88	102.87	185.72	317.55	468.56	1,368.99	2,465.48	3,541.58
Residential Buildings Integration				1.61	4.89	10.08	17.36	27.37	39.60	131.23	242.03	340.72
State Energy Program				5.50	10.86	16.12	21.23	25.91	29.72	56.00	78.37	99.06
Technology Roadmaps & Competitive R&D				0	4.07	6.94	10.86	17.94	25.03	99.86	218.70	347.02
Weatherization Assistance Program				6.73	13.38	21.67	30.29	39.07	47.63	95.65	140.54	183.95
BTS Total Primary Energy Displaced Total				69.69	131.34	232.63	381.98	592.12	827.51	2,290.10	4,048.45	5,692.34

Direct Electricity Displaced (Billion Kilowatthours)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration			0	0.50	0.80	1.70	2.70	4.20	6.10	21.50	43.10	65.20
Community Partnerships Program			0	0.40	0.90	1.80	2.80	4.00	5.10	12.30	19.60	25.00
Energy Star Program				0.20	0.50	1.00	1.60	2.40	3.20	7.10	11.10	15.00
Equipment, Materials, and Tools				3.60	5.50	9.30	14.30	22.10	32.10	98.50	180.50	257.20
Residential Buildings Integration			0	0.10	0.30	0.60	1.00	1.70	2.40	8.60	16.10	23.90
State Energy Program			0	0.30	0.70	1.00	1.40	1.70	2.00	3.80	5.50	7.20
Technology Roadmaps & Competitive R&D				0	0.30	0.50	0.80	1.40	2.10	8.60	18.30	27.50
Weatherization Assistance Program			0	0.20	0.40	0.70	0.90	1.20	1.50	2.90	4.40	5.80
BTS Direct Electricity Displaced Total			0	5.30	9.40	16.60	25.50	38.70	54.50	163.30	298.60	426.80

Direct Natural Gas Displaced (Billion Cubic Feet)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration			0	3.00	3.00	5.30	5.80	7.10	8.30	14.20	18.80	20.50
Community Partnerships Program			0	3.40	7.80	14.60	22.90	31.80	41.80	101.20	167.40	212.20
Energy Star Program				0.50	1.30	3.20	5.70	8.10	10.60	22.50	34.20	45.80
Equipment, Materials, and Tools				(8.50)	(9.60)	(1.90)	24.20	58.30	94.60	324.70	610.30	831.90
Residential Buildings Integration			0	0.60	1.50	3.00	4.90	7.60	11.20	37.70	71.50	104.20
State Energy Program			0	1.60	3.20	4.80	6.50	8.10	9.70	17.70	25.80	33.90
Technology Roadmaps & Competitive R&D				0	0	0	0.20	(0.80)	(1.80)	(10.20)	(16.40)	(10.30)
Weatherization Assistance Program			0	3.70	7.40	11.80	16.40	21.30	26.40	52.00	77.50	103.00
BTS Direct Natural Gas Displaced Total			0	4.30	14.60	40.80	86.60	141.50	200.80	559.80	989.10	1,341.20

Direct Petroleum Displaced (Million Barrels)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration			0	0	0	0.10	0.10	0.10	0.10	2.27	0.30	0.30
Community Partnerships Program			0	0	0.10	0.20	0.40	0.50	0.70	1.50	2.20	2.60
Energy Star Program				0	0	0	0.10	0.10	0.10	0.20	0.40	0.50
Equipment, Materials, and Tools				0.10	0.20	0.50	0.80	1.30	1.80	5.60	10.60	14.10
Residential Buildings Integration			0	0	0.10	0.20	0.30	0.50	0.70	2.40	4.30	5.90
State Energy Program			0	0.10	0.20	0.30	0.40	0.50	0.60	1.10	1.50	2.00
Technology Roadmaps & Competitive R&D				0	0	0	0	0	0.10	0.20	0.50	0.80
Weatherization Assistance Program			0	0.20	0.40	0.70	0.90	1.20	1.50	2.90	4.40	5.80
BTS Direct Petroleum Displaced Total			0	0.40	1.00	2.00	3.00	4.20	5.60	16.17	24.20	32.00

Direct Coal Displaced (Million Short Tons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration			0	0	0	0	0		0	0	0	0
Community Partnerships Program		0	0	0	0	0	0		0	0	0	0
Energy Star Program												
Equipment, Materials, and Tools												
Residential Buildings Integration		0	0	0	0	0	0		0	0	0	0
State Energy Program			0	0	0	0	0		0	0	0	0
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program		0	0	0	0	0	0		0	0	0	0
BTS Direct Coal Displaced Total		0	0	0	0	0	0		0	0	0	0

Financial

Energy Costs or Savings (Billions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration				$0.06	$0.09	$0.16	$0.24	$0.35	$0.49	$1.54	$2.83	$4.11
Community Partnerships Program				$0.05	$0.12	$0.23	$0.36	$0.49	$0.63	$1.49	$2.33	$2.97
Energy Star Program				$0.02	$0.05	$0.11	$0.19	$0.27	$0.37	$0.79	$1.17	$1.57
Equipment, Materials, and Tools				$0.30	$0.47	$0.80	$1.38	$2.28	$3.35	$9.73	$16.63	$23.77
Residential Buildings Integration				$0.01	$0.03	$0.07	$0.12	$0.20	$0.29	$0.99	$1.79	$2.60
State Energy Program				$0.03	$0.07	$0.10	$0.13	$0.17	$0.20	$0.36	$0.50	$0.65
Technology Roadmaps & Competitive R&D					$0.03	$0.05	$0.07	$0.12	$0.17	$0.65	$1.33	$2.03
Weatherization Assistance Program				$0.04	$0.08	$0.12	$0.17	$0.22	$0.27	$0.53	$0.78	$1.05
BTS Energy Costs or Savings Total				$0.52	$0.94	$1.64	$2.67	$4.10	$5.77	$16.08	$27.36	$38.74

Non-Energy Savings or Costs (Billions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration												
Community Partnerships Program												
Energy Star Program												
Equipment, Materials, and Tools												
Residential Buildings Integration												
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS Non-Energy Savings or Costs Total												

Environmental

CO Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration							0	0	0	0	0.01	0.01
Community Partnerships Program						0	0	0	0	0	0.01	0.01
Energy Star Program								0	0	0	0	0
Equipment, Materials, and Tools					0	0	0	0	0.01	0.02	0.04	0.05
Residential Buildings Integration									0	0	0	0.01
State Energy Program									0	0	0	0
Technology Roadmaps & Competitive R&D										0	0	0
Weatherization Assistance Program							0	0	0	0	0	0
BTS CO Displaced Total					0	0	0.01	0.01	0.01	0.04	0.06	0.08

Carbon Equivalent Emissions Displaced (MMTCe)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration				0.17	0.23	0.43	0.63	0.91	1.26	3.42	6.85	8.62
Community Partnerships Program				0.13	0.32	0.60	0.94	1.29	1.66	3.58	5.85	6.76
Energy Star Program				0.05	0.14	0.28	0.46	0.66	0.87	1.67	2.65	3.14
Equipment, Materials, and Tools				0.77	1.23	2.06	3.50	5.76	8.36	21.23	39.16	49.55
Residential Buildings Integration				0.03	0.09	0.18	0.31	0.49	0.70	2.17	4.16	5.50
State Energy Program				0.10	0.20	0.29	0.38	0.47	0.55	0.90	1.34	1.59
Technology Roadmaps & Competitive R&D				0	0.08	0.13	0.19	0.31	0.43	1.39	3.17	4.22
Weatherization Assistance Program				0.11	0.23	0.37	0.51	0.66	0.82	1.53	2.31	2.94
BTS Carbon Equivalent Emissions Displaced Total				1.36	2.50	4.33	6.93	10.56	14.66	35.88	65.48	82.32

Other Greenhouse Emissions Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration												
Community Partnerships Program												
Energy Star Program												
Equipment, Materials, and Tools												
Residential Buildings Integration												
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS Other Greenhouse Emissions Displaced Total												

SO2 Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration			0	0	0	0.01	0.01	0.01	0.01	0.03	0.08	0.07
Community Partnerships Program			0	0	0	0.01	0.01	0.01	0.02	0.03	0.05	0.04
Energy Star Program				0	0	0	0	0.01	0.01	0.01	0.02	0.02
Equipment, Materials, and Tools				0.01	0.01	0.03	0.04	0.06	0.08	0.16	0.37	0.33
Residential Buildings Integration			0	0	0	0	0	0.01	0.01	0.02	0.04	0.05
State Energy Program			0	0	0	0	0.01	0.01	0.01	0.01	0.01	0.01
Technology Roadmaps & Competitive R&D					0	0	0	0	0.01	0.01	0.03	0.03
Weatherization Assistance Program			0	0	0	0	0.01	0.01	0.01	0.01	0.02	0.03
BTS SO2 Displaced Total			0	0.02	0.03	0.05	0.08	0.11	0.15	0.28	0.63	0.57

NOX Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration			0	0	0	0	0.01	0.01	0.01	0.03	0.06	0.07
Community Partnerships Program			0	0	0	0.01	0.01	0.01	0.01	0.03	0.04	0.05
Energy Star Program					0	0	0	0.01	0.01	0.01	0.02	0.02
Equipment, Materials, and Tools				0.01	0.01	0.02	0.03	0.04	0.06	0.16	0.30	0.37
Residential Buildings Integration			0	0	0	0	0	0	0.01	0.02	0.03	0.04
State Energy Program			0	0	0	0	0	0	0.01	0.01	0.01	0.01
Technology Roadmaps & Competitive R&D					0	0	0	0	0	0.01	0.02	0.03
Weatherization Assistance Program			0	0	0	0	0	0.01	0.01	0.01	0.02	0.02
BTS NOX Displaced Total			0	0.01	0.02	0.03	0.05	0.08	0.11	0.26	0.51	0.60

Particulates Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration												
Community Partnerships Program												
Energy Star Program												
Equipment, Materials, and Tools												
Residential Buildings Integration												
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS Particulates Displaced Total												

VOCs Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration												
Community Partnerships Program												
Energy Star Program												
Equipment, Materials, and Tools										0	0	0
Residential Buildings Integration												
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS VOCs Displaced Total										0	0	0

HCs Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration												
Community Partnerships Program												
Energy Star Program												
Equipment, Materials, and Tools												
Residential Buildings Integration												
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS HCs Displaced Total												

Other Environmental Benefits (Thousand Tons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration												
Community Partnerships Program												
Energy Star Program												
Equipment, Materials, and Tools												
Residential Buildings Integration												
State Energy Program												
Technology Roadmaps & Competitive R&D												
Weatherization Assistance Program												
BTS Other Environmental Benefits Total												

PM10 Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Commercial Buildings Integration										0	0	0
Community Partnerships Program											0	
Energy Star Program												
Equipment, Materials, and Tools							0	0	0	0	0.01	0
Residential Buildings Integration											0	0
State Energy Program												
Technology Roadmaps & Competitive R&D											0	
Weatherization Assistance Program												
BTS PM10 Displaced Total							0	0	0	0	0.01	0.01

Federal Energy Management Program (FEMP)

Resource

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
DOE Funding Level (Millions of $'s)												
FEMP		$19.80	$33.87	$33.87	$33.87	$33.87	$33.87	$33.87	$33.87	$33.87	$33.87	$33.87
FEMP DOE Funding Level Total		$19.80	$33.87	$33.87	$33.87	$33.87	$33.87	$33.87	$33.87	$33.87	$33.87	$33.87
Research (%)												
FEMP	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Development (%)												
FEMP	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Deployment (%)												
FEMP	0%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Partner Financial Investment (Millions of $'s)												
FEMP			$50.00	$150.00	$250.00	$300.00	$350.00	$350.00	$350.00	$270.00		
FEMP Partner Financial Investment Total			$50.00	$150.00	$250.00	$300.00	$350.00	$350.00	$350.00	$270.00		
Partner Non-Financial Investment (Millions of $'s)												
FEMP												
FEMP Partner Non-Financial Investment Total												
Partners (Number)												
FEMP			33.00	100.00	165.00	200.00	233.00	233.00	233.00	180.00		
FEMP Partners Total			33.00	100.00	165.00	200.00	233.00	233.00	233.00	180.00		

Energy

Total Primary Energy Displaced (Trillion Btu)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
FEMP	0	0	0	24.00	28.66	33.23	37.70	42.09	46.38	66.52	66.52	66.52
FEMP Total Primary Energy Displaced Total	0	0	0	24.00	28.66	33.23	37.70	42.09	46.38	66.52	66.52	66.52

Direct Electricity Displaced (Billion Kilowatthours)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
FEMP			0	1.69	2.02	2.34	2.66	2.97	3.27	4.69	4.69	4.69
FEMP Direct Electricity Displaced Total			0	1.69	2.02	2.34	2.66	2.97	3.27	4.69	4.69	4.69

Direct Natural Gas Displaced (Billion Cubic Feet)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
FEMP			0	4.56	5.45	6.32	7.17	8.00	8.82	12.64	12.64	12.64
FEMP Direct Natural Gas Displaced Total			0	4.56	5.45	6.32	7.17	8.00	8.82	12.64	12.64	12.64

Direct Petroleum Displaced (Million Barrels)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
FEMP			0	0.35	0.41	0.48	0.54	0.60	0.67	0.96	0.96	0.96
FEMP Direct Petroleum Displaced Total			0	0.35	0.41	0.48	0.54	0.60	0.67	0.96	0.96	0.96

Direct Coal Displaced (Million Short Tons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
FEMP			0	0.07	0.08	0.09	0.10	0.12	0.13	0.18	0.18	0.18
FEMP Direct Coal Displaced Total			0	0.07	0.08	0.09	0.10	0.12	0.13	0.18	0.18	0.18

Financial

Energy Costs or Savings (Billions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
FEMP				$0.16	$0.19	$0.21	$0.27		$0.29	$0.40	$0.39	$0.38
FEMP Energy Costs or Savings Total				$0.16	$0.19	$0.21	$0.27		$0.29	$0.40	$0.39	$0.38

Non-Energy Savings or Costs (Billions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
FEMP												
FEMP Non-Energy Savings or Costs Total												

Environmental

CO Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
FEMP				0	0	0	0	0	0	0	0	0
FEMP CO Displaced Total				0	0	0	0	0	0	0	0	0

Carbon Equivalent Emissions Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
FEMP	0	0	0	0.44	0.52	0.60	0.69	0.77	0.84	1.21	1.21	1.21
FEMP Carbon Equivalent Emissions Displaced Total	0	0	0	0.44	0.52	0.60	0.69	0.77	0.84	1.21	1.21	1.21

Other Greenhouse Emissions Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
FEMP												
FEMP Other Greenhouse Emissions Displaced Total												

SO2 Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
FEMP			0	0.02	0.02	0.02	0.03	0.03	0.03	0.05	0.05	0.05
FEMP SO2 Displaced Total			0	0.02	0.02	0.02	0.03	0.03	0.03	0.05	0.05	0.05

NOX Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
FEMP			0	0.01	0.02	0.02	0.02	0.02	0.03	0.04	0.04	0.04
FEMP NOX Displaced Total			0	0.01	0.02	0.02	0.02	0.02	0.03	0.04	0.04	0.04

Particulates Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
FEMP				0	0	0	0	0	0	0	0	0
FEMP Particulates Displaced Total				0	0	0	0	0	0	0	0	0

VOCs Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
FEMP				0	0	0	0	0	0	0	0	0
FEMP VOCs Displaced Total				0	0	0	0	0	0	0	0	0

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020

HCs Displaced (MMTons)

FEMP												
FEMP HCs Displaced Total												

Other Environmental Benefits (Thousand Tons)

FEMP												
FEMP Other Environmental Benefits Total												

PM10 Displaced (MMTons)

FEMP												
FEMP PM10 Displaced Total												

Office of Industrial Technologies (OIT)

Resource

DOE Funding Level (Millions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)	$14.70	$14.47	$14.40	$14.40	$14.50	$14.50	$6.20	$6.30	$6.30	$6.30	$6.30	$6.30
Agriculture Vision												
Aluminum Vision	$5.59	$7.34	$8.18	$8.18	$9.70	$9.70	$10.50	$12.00	$12.00	$12.00	$12.00	$12.00
Chemicals Vision	$10.10	$11.61	$12.05	$12.50	$13.80	$15.20	$16.70	$18.40	$18.40	$18.40	$18.40	$18.40
Cogeneration	$24.60	$34.65	$31.00	$25.60	$25.60	$25.60	$25.60	$25.60	$25.60	$25.60	$25.60	$25.60
Forest & Paper Products Vision	$11.14	$12.04	$12.10	$12.10	$12.10	$12.10	$12.10	$12.10	$12.10	$12.10	$12.10	$12.10
Glass Vision	$3.00	$4.61	$5.00	$5.50	$6.00	$6.50	$7.00	$7.50	$7.50	$7.50	$7.50	$7.50
IAC	$7.20	$8.30	$8.30	$8.30	$8.30	$8.30	$8.30	$8.30	$8.30	$8.30	$8.30	$8.30
Integrated Delivery Program	$5.14	$6.23	$9.60	$11.00	$11.00	$11.00	$11.00	$11.00	$11.00	$11.00	$11.00	$11.00
Inventions & Innovations	$4.80	$4.96	$4.80	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00
Metals Casting Vision	$3.50	$5.40	$5.80	$5.90	$5.90	$6.00	$6.00	$6.10	$6.10	$6.10	$6.10	$6.10
Mining Vision												
NICE-3	$5.80	$6.00	$6.00	$7.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00	$8.00
Petroleum Refining Vision												
Steel Vision	$9.06	$10.06	$11.00	$13.00	$13.00	$13.00	$13.00	$13.00	$13.00	$13.00	$13.00	$13.00
OIT DOE Funding Level Total	$104.63	$125.67	$128.23	$128.48	$132.90	$134.90	$129.40	$133.30	$133.30	$133.30	$133.30	$133.30

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Research (%)												
Advanced Materials (CFCC and AIM)	0%	15.00%	15.00%	15.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Agriculture Vision	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Aluminum Vision	0%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%
Chemicals Vision	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%
Cogeneration	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%
Forest & Paper Products Vision	0%	50.00%	50.00%	40.00%	40.00%	30.00%	30.00%	30.00%	20.00%	20.00%	20.00%	20.00%
Glass Vision	0%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%
IAC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Integrated Delivery Program	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Inventions & Innovations	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Metals Casting Vision	0%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Mining Vision	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
NICE-3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Petroleum Refining Vision	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steel Vision	0%	20.00%	20.00%	15.00%	10.00%	10.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%
Development (%)												
Advanced Materials (CFCC and AIM)	0%	75.00%	75.00%	75.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%
Agriculture Vision	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Aluminum Vision	0%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%
Chemicals Vision	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%
Cogeneration	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%
Forest & Paper Products Vision	0%	50.00%	50.00%	60.00%	60.00%	70.00%	70.00%	70.00%	80.00%	80.00%	80.00%	80.00%
Glass Vision	0%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%
IAC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Integrated Delivery Program	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Inventions & Innovations	0%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%
Metals Casting Vision	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mining Vision	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
NICE-3	0%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%
Petroleum Refining Vision	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steel Vision	0%	70.00%	70.00%	70.00%	70.00%	70.00%	70.00%	70.00%	70.00%	70.00%	70.00%	70.00%

Deployment (%)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)	0%	10.00%	10.00%	10.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%
Agriculture Vision	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Aluminum Vision	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Chemicals Vision	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cogeneration	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Forest & Paper Products Vision	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Glass Vision	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
IAC	0%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Integrated Delivery Program	10000.00%	10000.00%	10000.00%	10000.00%	10000.00%	10000.00%	10000.00%	0000.00%	10000.00%	10000.00%	10000.00%	0000.00%
Inventions & Innovations	0%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%
Metals Casting Vision	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mining Vision	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
NICE-3	0%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%
Petroleum Refining Vision	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Steel Vision	0%	10.00%	10.00%	15.00%	20.00%	20.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%

Partner Financial Investment (Millions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)	$2.00	$2.00	$4.00	$4.00	$6.00	$6.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00
Agriculture Vision												
Aluminum Vision	$0.80	$1.30	$1.40	$1.40	$1.60	$1.60	$1.80	$2.00	$2.00	$2.00	$2.00	$2.00
Chemicals Vision	$8.10	$9.30		$10.00	$12.00	$13.00	$15.00	$16.00	$16.00	$16.00	$16.00	$16.00
Cogeneration	$13.50	$13.50	$13.50	$13.50	$13.50	$13.50	$13.50	$13.50	$13.50	$13.50	$13.50	$13.50
Forest & Paper Products Vision	$1.35	$0.95	$1.80	$1.70	$2.00	$2.20	$2.30	$2.40	$2.50	$2.50	$2.50	$2.50
Glass Vision	$2.40	$2.40	$3.50	$3.80	$4.00	$4.20	$4.40	$4.60	$4.60	$4.60	$4.60	$4.60
IAC	$29.90	$34.47	$34.47	$34.47	$34.47	$34.47	$34.47	$34.47				
Integrated Delivery Program	$9.45	$11.45	$17.65	$20.22	$20.22	$20.22	$20.22	$20.22	$20.22	$42.89	$62.58	$62.72
Inventions & Innovations	$3.84	$3.97	$3.84	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00			
Metals Casting Vision	$1.08	$1.40	$1.71	$1.75	$1.78	$1.82	$1.85	$1.88	$1.88	$1.88	$1.88	$1.88
Mining Vision												
NICE-3	$11.97	$12.38	$12.38	$14.45	$16.51	$16.51	$16.51	$16.51				
Petroleum Refining Vision												
Steel Vision	$2.33	$2.33	$2.64	$2.92	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00
OIT Partner Financial Investment Total	$86.72	$95.45	$96.89	$112.21	$119.08	$120.52	$120.05	$121.58	$70.70	$89.37	$109.06	$109.20

Partner Non-Financial Investment (Millions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)												
Agriculture Vision												
Aluminum Vision	$0.80	$1.30	$1.40	$1.40	$1.60	$1.60	$1.80	$2.00	$2.00	$2.00	$2.00	$2.00
Chemicals Vision	$1.90	$2.20	$4.00	$6.00	$7.00	$7.00	$8.00	$9.00	$9.00	$9.00	$9.00	$9.00
Cogeneration												
Forest & Paper Products Vision	$2.03	$3.79	$2.66	$2.53	$2.97	$3.30	$3.40	$3.60	$3.70	$3.70	$3.70	$3.70
Glass Vision	$0.60	$0.60	$1.20	$1.20	$1.40	$1.60	$1.80	$2.00	$2.00	$2.00	$2.00	$2.00
IAC	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75				
Integrated Delivery Program												
Inventions & Innovations	$1.53	$1.58	$1.53	$1.59	$1.59	$1.59	$1.59	$1.59	$1.59			
Metals Casting Vision	$2.52	$3.40	$6.07	$6.19	$6.31	$6.44	$6.55	$6.68	$6.68	$6.68	$6.68	$6.68
Mining Vision												
NICE-3	$0.07	$0.08	$0.08	$0.09	$0.10	$0.10	$0.10	$0.10				
Petroleum Refining Vision												
Steel Vision	$0.58	$0.58	$0.66	$0.97	$1.35	$1.53	$1.43	$1.58	$1.58	$1.58	$1.58	$1.58
OIT Partner Non-Financial Investment Total	$10.78	$14.28	$18.34	$20.73	$23.07	$23.91	$25.42	$27.30	$26.55	$24.95	$24.95	$24.95

Partners (Number)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)			60.00	60.00	60.00	60.00	20.00	22.00	22.00	22.00	22.00	22.00
Agriculture Vision												
Aluminum Vision	20.00	30.00	35.00	35.00	40.00	40.00	40.00	45.00	45.00	45.00	45.00	45.00
Chemicals Vision	14.00	15.00	30.00	42.00	46.00	48.00	50.00	55.00	55.00	55.00	55.00	55.00
Cogeneration	20.00	20.00	25.00	25.00	27.00	29.00	31.00	32.00	33.00	33.00	35.00	35.00
Forest & Paper Products Vision		60.00	60.00	65.00	65.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00
Glass Vision		37.00	37.00	40.00	42.00	46.00	48.00	50.00	50.00	50.00	50.00	50.00
IAC	14,438.80	15,778.80	17,118.80	18,458.80	19,798.80	21,138.80	22,478.80	23,818.80				
Integrated Delivery Program												
Inventions & Innovations	234.00	261.00	290.00	320.00	350.00	380.00	410.00	440.00	470.00			
Metals Casting Vision			270.00	272.00	275.00	278.00	280.00	283.00	283.00	283.00	283.00	283.00
Mining Vision												
NICE-3	234.00	261.00	297.00	339.00	387.00	435.00	483.00	531.00				
Petroleum Refining Vision												
Steel Vision		10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
OIT Partners Total	14,960.80	16,472.80	18,232.80	19,666.80	21,100.80	22,534.80	23,920.80	25,356.80	1,038.00	568.00	570.00	570.00

Energy

Total Primary Energy Displaced (Trillion Btu)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)									38.14	93.45	160.78	237.44
Agriculture Vision												
Aluminum Vision		0	0	0	0	0	0		20.50	49.00	108.00	187.00
Chemicals Vision									56.86	151.41	367.33	830.49
Cogeneration			13.61	27.23	40.84	54.45	68.06	81.68	95.29	198.37	352.56	435.22
Forest & Paper Products Vision									0	194.00	0	1,508.00
Glass Vision									23.00	40.00	56.00	73.00
IAC	49.40	62.00	67.00	71.00	76.00	79.00	82.00		86.00	93.00	97.00	99.00
Integrated Delivery Program			17.34	27.13	36.92	46.71	56.51	66.30	76.09	157.82	259.19	331.27
Inventions & Innovations			111.25	112.31	110.75	106.89	101.93	100.67	103.18	107.15	116.89	116.89
Metals Casting Vision									10.50	25.90	55.10	89.20
Mining Vision												
NICE-3			13.28	18.94	25.43	33.03	41.79	51.45	61.78	109.12	137.98	143.52
Petroleum Refining Vision				10.00					150.20	217.90	290.30	340.00
Steel Vision									14.17	36.34	72.99	110.40
OIT Total Primary Energy Displaced Total	49.40	62.00	222.48	266.60	289.94	320.09	350.29	300.10	735.71	1,473.45	2,074.12	4,501.43

Direct Electricity Displaced (Billion Kilowatthours)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)									0.70	1.68	2.74	3.71
Agriculture Vision												
Aluminum Vision		0	0	0	0	0	0		1.78	4.31	9.60	19.20
Chemicals Vision									2.05	4.09	9.69	17.65
Cogeneration			2.66	5.33	7.99	10.66	13.32	15.98	18.65	45.00	85.07	120.99
Forest & Paper Products Vision									1.36	3.91	9.32	16.90
Glass Vision									0.58	1.01	1.55	2.32
IAC	3.26	4.09	4.42	4.69	5.02	5.21	5.41		5.68	6.14	6.40	6.54
Integrated Delivery Program			1.20	1.89	2.58	3.28	3.97	4.66	5.35	10.99	17.08	21.56
Inventions & Innovations			3.87	3.91	3.86	3.72	3.55	3.50	3.96	4.45	5.01	5.38
Metals Casting Vision									0.84	2.15	4.69	7.91
Mining Vision												
NICE-3			0.46	0.66	0.90	1.19	1.54	1.93	2.37	4.53	5.92	6.60
Petroleum Refining Vision									(0.03)	(0.04)	(0.04)	(0.19)
Steel Vision									0.14	0.35	0.71	1.07
OIT Direct Electricity Displaced Total	3.26	4.09	12.62	16.48	20.35	24.06	27.78	26.08	43.42	88.58	157.73	229.63

Direct Natural Gas Displaced (Billion Cubic Feet)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)									28.24	69.34	115.45	167.46
Agriculture Vision												
Aluminum Vision		0	0	0	0	0	0		2.26	7.00	17.40	33.10
Chemicals Vision									34.87	101.59	255.48	516.03
Cogeneration			(10.39)	(20.78)	(31.17)	(41.56)	(51.96)	(62.35)	(72.74)	(175.53)	(331.85)	(471.95)
Forest & Paper Products Vision									1.87	5.46	13.50	24.10
Glass Vision									18.80	33.15	48.10	64.20
IAC	12.47	15.65	16.91	17.92	19.18	19.94	20.70		21.71	23.48	24.49	24.99
Integrated Delivery Program			3.16	6.32	9.48	12.64	15.80	18.96	22.12	52.82	97.08	135.41
Inventions & Innovations			32.43	32.74	32.29	31.16	29.72	29.35	30.08	31.24	34.08	34.08
Metals Casting Vision									2.27	5.96	13.20	23.00
Mining Vision												
NICE-3			3.87	5.52	7.42	9.63	12.18	15.00	18.01	31.81	40.23	41.84
Petroleum Refining Vision									17.95	47.84	88.32	109.90
Steel Vision									6.15	15.48	30.16	44.85
OIT Direct Natural Gas Displaced Total	12.47	15.65	45.98	41.72	37.19	31.81	26.44	0.96	131.59	249.65	445.64	747.00

Direct Petroleum Displaced (Million Barrels)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)									0	0	0	0
Agriculture Vision												
Aluminum Vision		0	0	0	0	0	0		0	0	0	0
Chemicals Vision									0.02	0.04	0.08	0.14
Cogeneration			0	0	0	0	0	0	0	0	0	0
Forest & Paper Products Vision									0	0	0	0
Glass Vision									0.10	0.17	0.20	0.24
IAC	0.34	0.43	0.46	0.49	0.52	0.54	0.57		0.59	0.64	0.67	0.68
Integrated Delivery Program			0.03	0.05	0.08	0.10	0.13	0.16	0.18	0.44	0.81	1.12
Inventions & Innovations			5.56	5.62	5.54	5.34	5.10	5.03	5.16	5.36	5.84	5.84
Metals Casting Vision									0.18	0.47	0.99	1.55
Mining Vision												
NICE-3			0.66	0.95	1.27	1.65	2.09	2.57	3.09	5.46	6.90	7.18
Petroleum Refining Vision									22.68	28.92	34.24	38.94
Steel Vision									0.02	0.04	0.09	0.14
OIT Direct Petroleum Displaced Total	0.34	0.43	6.71	7.10	7.41	7.64	7.89	7.76	32.02	41.53	49.82	55.84

Direct Coal Displaced (Million Short Tons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)									0.13	0.38	0.94	1.75
Agriculture Vision												
Aluminum Vision		0	0	0	0	0	0		0	0	0.01	0.01
Chemicals Vision									3.99	11.67	27.31	48.41
Cogeneration			0	0	0	0	0	0	0	0	0	0
Forest & Paper Products Vision									0.29	0.83	2.00	3.77
Glass Vision									0	0	0	0
IAC	0.05	0.06	0.06	0.07	0.07	0.07	0.08		0.08	0.09	0.09	0.09
Integrated Delivery Program			0.02	0.05	0.07	0.10	0.12	0.14	0.17	0.40	0.73	1.02
Inventions & Innovations			0.32	0.32	0.32	0.31	0.29	0.29	0.30	0.31	0.34	0.34
Metals Casting Vision									0.01	0.04	0.09	0.16
Mining Vision												
NICE-3			0.04	0.05	0.07	0.10	0.12	0.15	0.18	0.31	0.40	0.41
Petroleum Refining Vision				0					0	0	0	0
Steel Vision									0.23	0.61	1.26	1.97
OIT Direct Coal Displaced Total	0.05	0.06	0.44	0.50	0.53	0.57	0.61	0.58	5.37	14.65	33.17	57.93

Financial

Energy Costs or Savings (Billions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)									$0.12	$0.29	$0.48	$0.73
Agriculture Vision												
Aluminum Vision									$0.08	$0.20	$0.41	$0.60
Chemicals Vision									$0.13	$0.34	$0.53	$1.02
Cogeneration			$0.08	$0.16	$0.24	$0.32	$0.40	$0.48	$0.56	$1.21	$2.08	$2.71
Forest & Paper Products Vision										$0.74		$5.66
Glass Vision									$0.08	$0.15	$0.21	$0.31
IAC	$0.21	$0.26	$0.28	$0.30	$0.32	$0.33	$0.34		$0.35	$0.37	$0.38	$0.38
Integrated Delivery Program			$0.08	$0.11	$0.15	$0.18	$0.22	$0.25	$0.29	$0.60	$0.96	$1.25
Inventions & Innovations			$0.43	$0.43	$0.43	$0.41	$0.39	$0.39	$0.42	$0.45	$0.48	$0.50
Metals Casting Vision									$0.04	$0.09	$0.18	$0.31
Mining Vision												
NICE-3			$0.05	$0.07	$0.10	$0.13	$0.17	$0.21	$0.25	$0.46	$0.57	$0.62
Petroleum Refining Vision									$0.46	$0.66	$0.86	$0.99
Steel Vision									$0.03	$0.07	$0.15	$0.24
OIT Energy Costs or Savings Total	$0.21	$0.26	$0.92	$1.08	$1.23	$1.37	$1.52	$1.33	$2.80	$5.63	$7.29	$15.32

Non-Energy Savings or Costs (Billions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)										$0.01	$0.01	$0.01
Agriculture Vision												
Aluminum Vision									$0.05	$0.09	$0.17	$0.31
Chemicals Vision									$0.11	$0.31	$0.76	$1.42
Cogeneration				$0.03	$0.16	$0.20	$0.22		$0.27	$0.43	$0.69	$1.08
Forest & Paper Products Vision											$0.01	$0.01
Glass Vision												
IAC	$0.34	$0.43	$0.47	$0.49	$0.52	$0.54	$0.56		$0.58	$0.62	$0.63	$0.62
Integrated Delivery Program												
Inventions & Innovations	$0.41	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42		$0.42	$0.43	$0.42	$0.41
Metals Casting Vision									$0.01	$0.23	$0.55	$0.92
Mining Vision												
NICE-3			$0.01	$0.01	$0.03	$0.04	$0.07		$0.13	$0.39	$0.70	$0.90
Petroleum Refining Vision									$0.22	$0.52	$0.81	$1.24
Steel Vision										$0.01	$0.02	$0.03
OIT Non-Energy Savings or Costs Total	$0.75	$0.85	$0.90	$0.95	$1.12	$1.21	$1.27		$1.79	$3.03	$4.77	$6.95

Environmental

CO Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)									0	0	0	0
Agriculture Vision												
Aluminum Vision		0	0	0	0	0	0		0	0	0	0
Chemicals Vision									0	0	0	0.01
Cogeneration			0	0	0	0	0	0	0	0	0.01	0.01
Forest & Paper Products Vision									0	0	0	0
Glass Vision									0	0	0	0
IAC			0	0	0	0	0	0	0	0	0	0
Integrated Delivery Program			0	0	0	0	0	0	0	0	0	0.01
Inventions & Innovations			0	0	0	0	0	0	0	0	0	0
Metals Casting Vision									0	0	0	0
Mining Vision												
NICE-3			0	0	0	0	0	0	0	0	0	0
Petroleum Refining Vision												
Steel Vision									0	0	0	0
OIT CO Displaced Total		0	0	0	0	0	0.01	0.01	0.01	0.02	0.03	0.04

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Carbon Equivalent Emissions Displaced (MMTCe)												
Advanced Materials (CFCC and AIM)									0.62	1.65	2.72	4.11
Agriculture Vision												
Aluminum Vision		0	0	0	0	0	0		0.41	1.04	2.37	4.44
Chemicals Vision									0.75	1.87	4.13	7.58
Cogeneration			0.33	0.65	0.98	1.31	1.64	1.96	2.29	5.52	10.44	14.85
Forest & Paper Products Vision									0	4.56	0	37.28
Glass Vision									0.40	0.70	1.02	1.41
IAC	1.05	1.32	1.43	1.51	1.62	1.68	1.74		1.83	1.98	2.06	2.11
Integrated Delivery Program			0.41	0.58	0.75	0.91	1.08	1.24	1.41	3.05	5.03	6.61
Inventions & Innovations			2.11	2.12	2.09	2.01	1.91	1.88	1.85	1.96	2.07	2.07
Metals Casting Vision									0.19	0.51	1.10	1.87
Mining Vision												
NICE-3			0.25	0.36	0.48	0.62	0.78	0.96	1.11	2.00	2.45	2.55
Petroleum Refining Vision									2.86	4.02	5.24	6.06
Steel Vision									0.24	0.63	1.29	1.94
OIT Carbon Equivalent Emissions Displaced Total	1.05	1.32	4.53	5.22	5.91	6.53	7.15	6.05	13.96	29.47	39.94	92.89
Other Greenhouse Emissions Displaced (MMTCe)												
Advanced Materials (CFCC and AIM)									0	0	0	0
Agriculture Vision												
Aluminum Vision		0	0	0	0	0	0		0	0	0	0
Chemicals Vision									0	0	0	0
Cogeneration			0	0	0	0	0	0	0	0	0	0
Forest & Paper Products Vision									0	0.01	0	0
Glass Vision									0	0	0	0
IAC			0.27	0.28	0.29	0.30	0.31	0.32	0.30	0.30	0.28	0.28
Integrated Delivery Program			0	0	0	0	0	0	0	0	0	0
Inventions & Innovations			0	0	0	0	0	0	0	0	0	0
Metals Casting Vision									0	0	0	0
Mining Vision												
NICE-3			0	0	0	0	0	0	0	0	0	0
Petroleum Refining Vision												
Steel Vision									0	0	0	0
OIT Other Greenhouse Emissions Displaced Total		0	0.27	0.28	0.29	0.30	0.31	0.32	0.30	0.31	0.29	0.29

SO2 Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)									0	0.01	0.02	0.04
Agriculture Vision												
Aluminum Vision		0	0	0	0	0	0		0	0.01	0.02	0.04
Chemicals Vision									0	0.01	0.02	0.04
Cogeneration			0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.08	0.16	0.23
Forest & Paper Products Vision									0.01	0.01	0.04	0.08
Glass Vision									0	0	0.01	0.01
IAC			26.90	28.20	28.65	29.05	29.32	29.33	20.35	23.84	17.22	16.96
Integrated Delivery Program			0	0	0	0.01	0.01	0.01	0.01	0.03	0.05	0.07
Inventions & Innovations			0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Metals Casting Vision									0	0.01	0.01	0.02
Mining Vision												
NICE-3			0	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.03
Petroleum Refining Vision									0.02	0.03	0.04	0.05
Steel Vision									0	0.01	0.02	0.03
OIT SO2 Displaced Total		0	26.94	28.25	28.71	29.11	29.40	29.42	20.49	24.10	17.67	17.62

NOX Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)									0	0.01	0.02	0.03
Agriculture Vision												
Aluminum Vision		0	0	0	0	0	0		0	0	0.02	0.03
Chemicals Vision									0	0.01	0.03	0.05
Cogeneration			0	0.01	0.01	0.01	0.01	0.02	0.02	0.05	0.10	0.14
Forest & Paper Products Vision									0	0.01	0.03	0.16
Glass Vision									0	0.01	0.01	0.01
IAC			18.57	19.70	20.27	20.82	21.31	21.61	19.23	19.89	17.99	17.62
Integrated Delivery Program			0	0	0	0.01	0.01	0.01	0.01	0.03	0.04	0.05
Inventions & Innovations			0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Metals Casting Vision									0	0	0.01	0.02
Mining Vision												
NICE-3			0	0	0	0	0.01	0.01	0.01	0.01	0.02	0.02
Petroleum Refining Vision									0	0.01	0.01	0.02
Steel Vision									0	0.01	0.01	0.02
OIT NOX Displaced Total		0	18.59	19.72	20.30	20.86	21.35	21.66	19.31	20.06	18.29	18.19

Particulates Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)									0	0	0	0
Agriculture Vision												
Aluminum Vision		0	0	0	0	0	0		0	0	0	0
Chemicals Vision									0.01	0.03	0.07	0.12
Cogeneration			0	0	0	0	0	0	0	0	0.01	0.01
Forest & Paper Products Vision									0	0	0	0
Glass Vision									0	0	0	0
IAC			0.66	0.69	0.69	0.70	0.70	0.69	0.41	0.52	0.31	0.31
Integrated Delivery Program			0	0	0	0	0	0	0	0	0	0
Inventions & Innovations			0	0	0	0	0	0	0	0	0	0
Metals Casting Vision									0	0	0	0
Mining Vision												
NICE-3			0	0	0	0	0	0	0	0	0	0
Petroleum Refining Vision									0	0	0	0.01
Steel Vision									0.01	0.02	0.04	0.05
OIT Particulates Displaced Total		0	0.66	0.69	0.69	0.70	0.70	0.70	0.43	0.58	0.44	0.51

VOCs Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)									0	0	0	0
Agriculture Vision												
Aluminum Vision		0	0	0	0	0	0		0	0	0	0
Chemicals Vision									0.01	0.02	0.03	0.05
Cogeneration			0	0	0	0	0	0	0	0	0	0
Forest & Paper Products Vision									0.29	0.81	1.89	3.32
Glass Vision									0	0	0	0
IAC			0.14	0.15	0.15	0.16	0.16	0.17	0.17	0.17	0.17	0.17
Integrated Delivery Program			0	0	0	0	0	0	0	0	0	0
Inventions & Innovations			0	0	0	0	0	0	0	0	0	0
Metals Casting Vision									1.11	2.96	6.18	9.70
Mining Vision												
NICE-3			0	0	0	0	0	0	0	0	0	0
Petroleum Refining Vision									0	0	0	0
Steel Vision									0	0	0	0
OIT VOCs Displaced Total		0	0.14	0.15	0.15	0.16	0.16	0.17	1.58	3.96	8.28	13.25

HCs Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)									0	0	0	0
Agriculture Vision												
Aluminum Vision		0	0	0	0	0	0		0	0	0	0
Chemicals Vision									0.11	0.27	0.65	1.48
Cogeneration		0	0	0	0	0	0		0	0	0	0
Forest & Paper Products Vision									0	0	0	0
Glass Vision									0	0	0	0
IAC												
Integrated Delivery Program												
Inventions & Innovations												
Metals Casting Vision									0	0	0	0
Mining Vision												
NICE-3												
Petroleum Refining Vision												
Steel Vision									0	0	0	0
OIT HCs Displaced Total		0	0	0	0	0	0		0.11	0.27	0.65	1.48

Other Environmental Benefits (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Materials (CFCC and AIM)									0	0	0	0
Agriculture Vision												
Aluminum Vision		0	0	0	0	0	0		0	0	0	0
Chemicals Vision									6.02	18.33	47.03	96.85
Cogeneration		0	0	0	0	0	0		0	0	0	0
Forest & Paper Products Vision									0	0	0	0
Glass Vision									0	0	0	0
IAC												
Integrated Delivery Program												
Inventions & Innovations												
Metals Casting Vision									0	0	0	0
Mining Vision												
NICE-3												
Petroleum Refining Vision												
Steel Vision									0	0	0	0
OIT Other Environmental Benefits Total		0	0	0	0	0	0		6.02	18.33	47.03	96.85

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
PM10 Displaced (MMTons)												
Advanced Materials (CFCC and AIM)												
Agriculture Vision												
Aluminum Vision												
Chemicals Vision												
Cogeneration												
Forest & Paper Products Vision												
Glass Vision												
IAC												
Integrated Delivery Program												
Inventions & Innovations												
Metals Casting Vision												
Mining Vision												
NICE-3												
Petroleum Refining Vision												
Steel Vision												
OIT PM10 Displaced Total												

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020

Office of Power Technologies (OPT)

Resource

DOE Funding Level (Millions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D	$25.80	$26.25	$41.00	$41.40	$41.60	$37.00	$32.00	$32.00	$36.50	$36.50	$36.50	$36.50
Energy Storage		$3.89	$7.00	$9.00	$10.00	$11.00	$12.00	$12.00	$13.00	$16.00	$21.00	$26.00
Geothermal Energy R&D	$30.00	$29.50	$33.00	$29.50	$29.00	$33.00	$35.00	$35.00	$30.00	$30.00	$30.00	$30.00
High Temperature Superconductivity		$31.50	$32.50	$32.50	$32.50	$32.50	$32.50	$32.50	$32.50	$32.50	$32.50	$32.50
Hydrogen		$13.25	$24.00	$24.00	$25.00	$27.00	$37.00	$40.00	$13.00	$16.00	$21.00	$26.00
Hydropower	$1.00	$0.75	$4.00	$7.00	$9.00	$70.00	$70.00	$70.00	$70.00	$70.00	$70.00	$70.00
Open Solicitation												
Photovoltaic Systems R&D	$60.00	$65.50	$78.80	$80.50	$84.00	$84.00	$80.00	$76.00	$75.00	$75.00	$75.00	$75.00
Power Systems Integration		$1.00		$4.00	$4.00	$4.00	$6.00	$8.00	$8.00	$8.00	$8.00	
Solar Buildings	$5.00	$5.00	$5.00	$5.50	$5.50	$5.50	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00
Solar International	$0.80	$1.38	$3.40	$2.50	$2.50	$2.50	$2.50	$2.50	$7.00	$7.00	$7.00	$7.00
Solar Thermal	$22.50	$16.80	$22.50	$18.70	$18.70	$18.30	$18.00	$18.00	$19.50	$19.50	$19.50	$19.50
Wind Energy R&D	$28.60	$32.50	$43.50	$42.60	$41.00	$40.00	$38.00	$38.00	$42.90	$42.90	$42.90	$42.90
OPT DOE Funding Level Total	$173.70	$227.31	$294.70	$297.20	$302.80	$364.80	$368.00	$369.00	$352.40	$358.40	$368.40	$370.40

Research (%)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D	0%	1500.00%	1500.00%	1500.00%	1500.00%	1500.00%	1500.00%	1500.00%	1000.00%	1000.00%	1000.00%	1000.00%
Energy Storage	0%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%
Geothermal Energy R&D	0%	800.00%	800.00%	800.00%	800.00%	800.00%	800.00%	800.00%	800.00%	800.00%	800.00%	800.00%
High Temperature Superconductivity	0%	7000.00%	7000.00%	7000.00%	7100.00%	7200.00%	7300.00%	7300.00%	7400.00%	7500.00%	7500.00%	7500.00%
Hydrogen	0%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%
Hydropower	0%	9000.00%	8000.00%	8000.00%	7000.00%	7000.00%	7000.00%	7000.00%	7000.00%	7000.00%	7000.00%	7000.00%
Open Solicitation	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Photovoltaic Systems R&D	0%	2100.00%	1900.00%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%	1300.00%	1300.00%	1300.00%	1300.00%
Power Systems Integration	0%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%	1000.00%	1000.00%	1000.00%	1000.00%	1000.00%
Solar Buildings	0%	3000.00%	4000.00%	4000.00%	4000.00%	4000.00%	4000.00%	4000.00%	4000.00%	4000.00%	4000.00%	4000.00%
Solar International	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Solar Thermal	0%	2900.00%	1700.00%	2200.00%	2900.00%	2400.00%	2100.00%	1900.00%	4000.00%	4000.00%	4000.00%	4000.00%
Wind Energy R&D	0%	5000.00%	5000.00%	5000.00%	5000.00%	5000.00%	5000.00%	5000.00%	5000.00%	5000.00%	5000.00%	5000.00%

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Development (%)												
Biomass Power R&D	0%	8500.00%	8500.00%	8000.00%	7500.00%	7500.00%	7000.00%	7000.00%	7500.00%	7000.00%	7000.00%	7000.00%
Energy Storage	0%	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%
Geothermal Energy R&D	0%	8200.00%	8200.00%	8900.00%	8900.00%	8900.00%	8900.00%	8900.00%	8900.00%	8900.00%	8900.00%	8900.00%
High Temperature Superconductivity	0%	3000.00%	3000.00%	3000.00%	2900.00%	2800.00%	2700.00%	2700.00%	2600.00%	2500.00%	2500.00%	2500.00%
Hydrogen	0%	8000.00%	8000.00%	8000.00%	7500.00%	7000.00%	7000.00%	7000.00%	6000.00%	5500.00%	5500.00%	5500.00%
Hydropower	0%	1000.00%	2000.00%	2000.00%	3000.00%	3000.00%	3000.00%	3000.00%	3000.00%	3000.00%	3000.00%	3000.00%
Open Solicitation	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Photovoltaic Systems R&D	0%	6300.00%	6000.00%	6300.00%	6300.00%	6300.00%	6300.00%	6300.00%	6100.00%	6100.00%	6100.00%	6100.00%
Power Systems Integration	0%	8000.00%	8000.00%	8000.00%	8000.00%	7000.00%	7000.00%	8000.00%	8000.00%	8000.00%	8000.00%	8000.00%
Solar Buildings	0%	3500.00%	4000.00%	4000.00%	4000.00%	4000.00%	4000.00%	4000.00%	4000.00%	4000.00%	4000.00%	4000.00%
Solar International	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Solar Thermal	0%	7100.00%	8300.00%	7800.00%	7100.00%	7600.00%	7900.00%	8100.00%	6000.00%	6000.00%	6000.00%	6000.00%
Wind Energy R&D	0%	5000.00%	5000.00%	5000.00%	5000.00%	5000.00%	5000.00%	5000.00%	5000.00%	5000.00%	5000.00%	5000.00%

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Deployment (%)												
Biomass Power R&D	0%	0%	0%	500.00%	1000.00%	1000.00%	1500.00%	1500.00%	1500.00%	2000.00%	2000.00%	2000.00%
Energy Storage	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Geothermal Energy R&D	0%	1000.00%	1000.00%	300.00%	300.00%	300.00%	300.00%	300.00%	300.00%	300.00%	300.00%	300.00%
High Temperature Superconductivity	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Hydrogen	0%	0%	0%	0%	500.00%	1000.00%	1000.00%	1000.00%	2000.00%	2500.00%	2500.00%	2500.00%
Hydropower	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Open Solicitation	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Photovoltaic Systems R&D	0%	1600.00%	2100.00%	1700.00%	1700.00%	1700.00%	1700.00%	1700.00%	2600.00%	2600.00%	2600.00%	2600.00%
Power Systems Integration	0%	0%	0%	0%	0%	1000.00%	1000.00%	1000.00%	1000.00%	1000.00%	1000.00%	1000.00%
Solar Buildings	0%	3500.00%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%	2000.00%
Solar International	0%	10000.00%	10000.00%	10000.00%	10000.00%	10000.00%	10000.00%	10000.00%	10000.00%	10000.00%	10000.00%	10000.00%
Solar Thermal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Wind Energy R&D	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Partner Financial Investment (Millions of $'s)												
Biomass Power R&D	$3.00	$4.00	$20.00	$20.00	$20.00	$18.00	$16.00	$16.00	$50.00	$50.00	$50.00	$50.00
Energy Storage	$1.00	$1.30	$3.00	$3.90	$4.30	$4.70	$5.10		$5.60	$6.90	$9.00	$11.10
Geothermal Energy R&D		$8.00	$8.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00
High Temperature Superconductivity	$8.00	$10.00	$10.00	$11.00	$12.00	$13.00	$13.00		$15.00	$17.00	$20.00	$20.00
Hydrogen	$2.85	$4.40	$7.60	$10.00	$12.00	$14.00	$16.00	$18.00	$5.60	$6.90	$9.00	$11.10
Hydropower		$0.02	$0.40	$1.50	$2.70	$4.00	$5.00	$5.00	$5.00			
Open Solicitation												
Photovoltaic Systems R&D	$2.00	$2.00	$2.50	$2.50	$2.50	$6.50	$2.50	$2.50	$30.00	$30.00	$30.00	$30.00
Power Systems Integration				$0.50	$1.50	$3.00	$6.00	$8.00				
Solar Buildings	$0.90	$2.20		$3.00	$3.00	$3.00	$3.00	$3.00				
Solar International	$15.00	$20.00	$25.00	$25.00	$25.00	$20.00	$20.00	$20.00	$10.00	$10.00	$10.00	$10.00
Solar Thermal	$5.80	$5.00	$8.60	$10.00	$10.00	$10.00	$20.00	$30.00	$150.00	$350.00	$500.00	$600.00
Wind Energy R&D	$4.00	$8.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00	$7.00	$7.00	$7.00	$7.00
OPT Partner Financial Investment Total	$42.55	$64.92	$97.10	$104.40	$110.00	$113.20	$123.60	$119.50	$283.20	$482.80	$640.00	$744.20
Partner Non-Financial Investment (Millions of $'s)												
Biomass Power R&D	$4.00	$5.00	$20.00	$20.00	$20.00	$19.00	$16.00	$16.00				
Energy Storage	$0.70	$1.70	$2.30	$2.90	$3.20	$3.50	$3.90		$4.20	$5.10	$6.80	$8.40
Geothermal Energy R&D	$15.00	$12.00	$22.00	$22.00	$22.00	$22.00	$12.00	$12.00	$12.00	$12.00	$12.00	$12.00
High Temperature Superconductivity												
Hydrogen		$1.20	$0.90	$1.00	$1.20	$1.40	$1.60	$1.80				
Hydropower	$0.15	$0.15	$0.15	$0.15	$0.15	$0.15	$0.15	$0.15	$0.15	$0.15		
Open Solicitation												
Photovoltaic Systems R&D									$2.00	$2.00	$2.00	$2.00
Power Systems Integration		$0.50	$0.50	$0.50	$1.00	$2.00	$2.00	$2.00				
Solar Buildings												
Solar International	$5.00	$5.00	$10.00	$10.00	$15.00	$15.00	$10.00	$10.00				
Solar Thermal	$1.80	$1.30	$1.50	$2.00	$2.00	$2.00	$2.00	$2.00	$1.00	$1.00	$1.00	$1.00
Wind Energy R&D	$2.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$4.00	$1.00	$1.00	$1.00	$1.00
OPT Partner Non-Financial Investment Total	$28.65	$30.85	$61.35	$62.55	$68.55	$69.05	$51.65	$47.95	$20.35	$21.25	$22.80	$24.40

Partners (Number)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D	20.00	20.00	25.00	25.00	25.00	25.00	25.00	30.00	100.00	100.00	100.00	100.00
Energy Storage		20.00	21.00	22.00	25.00	27.00	29.00		30.00	33.00	35.00	38.00
Geothermal Energy R&D		50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
High Temperature Superconductivity		34.00	35.00	37.00	39.00	42.00	45.00		50.00	55.00	60.00	65.00
Hydrogen		27.00	23.00	25.00	28.00	30.00	32.00	34.00	30.00	33.00	35.00	38.00
Hydropower	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00		
Open Solicitation												
Photovoltaic Systems R&D	20.00	20.00	20.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Power Systems Integration		1.00	1.00	2.00	5.00	8.00	10.00	10.00				
Solar Buildings	15.00	20.00	30.00	30.00	30.00	30.00	30.00	30.00				
Solar International	25.00	30.00	40.00	40.00	30.00	30.00	20.00	20.00	30.00	30.00	30.00	30.00
Solar Thermal	20.00	22.00	24.00	26.00	26.00	26.00	26.00	26.00	20.00	30.00	40.00	50.00
Wind Energy R&D	6.00	8.00	10.00	12.00	12.00	12.00	12.00	4.00	10.00	10.00	10.00	10.00
OPT Partners Total	123.00	269.00	296.00	311.00	312.00	322.00	321.00	246.00	362.00	383.00	385.00	406.00

Energy

Total Primary Energy Displaced (Trillion Btu)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D				28.00					215.05	422.07	478.32	532.54
Energy Storage				0.48					0.65	0.82	1.02	1.22
Geothermal Energy R&D				55.91					130.08	182.25	264.10	247.73
High Temperature Superconductivity				0					0	0.13	1.79	8.51
Hydrogen				4.46					43.00	92.44	252.62	641.86
Hydropower				7.93					25.18	79.69	147.93	183.04
Open Solicitation				0.55					2.98	2.98	2.98	2.98
Photovoltaic Systems R&D				0.25					1.15	5.85	16.56	49.38
Power Systems Integration				22.94					118.64	123.92	128.76	132.13
Solar Buildings				3.10					13.14	30.46	60.48	112.32
Solar International												
Solar Thermal				0					0.37	4.04	14.18	29.21
Wind Energy R&D				20.28					147.36	207.03	402.44	612.88
OPT Total Primary Energy Displaced Total				143.90					697.60	1,151.68	1,771.18	2,553.80

Direct Electricity Displaced (Billion Kilowatthours)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D												
Energy Storage												
Geothermal Energy R&D				0					0	0	0	0
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Open Solicitation												
Photovoltaic Systems R&D												
Power Systems Integration												
Solar Buildings												
Solar International												
Solar Thermal				0					0	0	0	0
Wind Energy R&D												
OPT Direct Electricity Displaced Total				0					0	0	0	0

Direct Natural Gas Displaced (Billion Cubic Feet)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D				0					0	0	0	0
Energy Storage												
Geothermal Energy R&D				0					0	0	0	0
High Temperature Superconductivity												
Hydrogen				0					0	0	0	0
Hydropower												
Open Solicitation												
Photovoltaic Systems R&D												
Power Systems Integration												
Solar Buildings												
Solar International												
Solar Thermal				0					0	0	0	0
Wind Energy R&D												
OPT Direct Natural Gas Displaced Total				0					0	0	0	0

Direct Petroleum Displaced (Million Barrels)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D				0					0	0	0	0
Energy Storage												
Geothermal Energy R&D				0					0	0	0	0
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Open Solicitation												
Photovoltaic Systems R&D												
Power Systems Integration												
Solar Buildings												
Solar International												
Solar Thermal				0					0	0	0	0
Wind Energy R&D												
OPT Direct Petroleum Displaced Total				0					0	0	0	0

Direct Coal Displaced (Million Short Tons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D				0					0	0	0	0
Energy Storage												
Geothermal Energy R&D				0					0	0	0	0
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Open Solicitation												
Photovoltaic Systems R&D												
Power Systems Integration												
Solar Buildings												
Solar International												
Solar Thermal				0					0	0	0	0
Wind Energy R&D												
OPT Direct Coal Displaced Total				0					0	0	0	0

Financial

Energy Costs or Savings (Billions of 1995 $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D				$0.01					($0.06)	($0.15)	($0.16)	($0.21)
Energy Storage												
Geothermal Energy R&D				$0.11					$0.27	$0.46	$0.65	$0.71
High Temperature Superconductivity									$0.30	$0.24	$0.56	$1.03
Hydrogen				($0.01)					($0.05)	$0.10	$0.51	$0.71
Hydropower				$0.02					$0.05	$0.20	$0.37	$0.53
Open Solicitation												$0.01
Photovoltaic Systems R&D										$0.02	$0.05	$0.16
Power Systems Integration												
Solar Buildings									$0.07	$0.15	$0.30	$0.75
Solar International												
Solar Thermal										$0.01	$0.04	$0.09
Wind Energy R&D				$0.04					$0.31	$0.52	$0.99	$1.76
OPT Energy Costs or Savings Total				$0.17					$0.91	$1.55	$3.32	$5.54

Non-Energy Savings or Costs (Billions of 1995 $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Open Solicitation												
Photovoltaic Systems R&D											($0.01)	($0.02)
Power Systems Integration												
Solar Buildings												
Solar International												
Solar Thermal												
Wind Energy R&D												
OPT Non-Energy Savings or Costs Total											($0.01)	($0.02)

Environmental

CO Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D				0					0	0	0	0
Energy Storage												
Geothermal Energy R&D				0					0	0	0	0
High Temperature Superconductivity				0					0	0	0	0
Hydrogen				0					0	0	0	0
Hydropower				0					0	0	0	0
Open Solicitation												
Photovoltaic Systems R&D				0					0	0	0	0
Power Systems Integration												
Solar Buildings												
Solar International												
Solar Thermal				0					0	0	0	0
Wind Energy R&D				0					0	0	0	0
OPT CO Displaced Total				0					0	0	0	0

Carbon Equivalent Emissions Displaced (MMTCe)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D				0.62					5.31	10.49	11.83	12.95
Energy Storage				0.01					0.01	0.02	0.02	0.02
Geothermal Energy R&D				1.08					3.40	3.10	4.81	4.06
High Temperature Superconductivity				0					0	0	0.03	0.14
Hydrogen				0.06					0.62	1.34	3.66	9.31
Hydropower				0.15					0.48	1.35	2.69	3.00
Open Solicitation				0.01					0.06	0.06	0.06	0.06
Photovoltaic Systems R&D				0					0.02	0.08	0.24	0.72
Power Systems Integration				0.50					2.61	2.70	2.77	2.82
Solar Buildings				0.05					0.21	0.47	0.95	1.70
Solar International	2.70	3.80	4.10	4.50	5.00	5.50	6.00	6.50	7.20	10.50	14.00	18.00
Solar Thermal				0					0.01	0.06	0.21	0.42
Wind Energy R&D				0.39					2.81	3.52	7.32	10.05
OPT Carbon Equivalent Emissions Displaced Total	2.70	3.80	4.10	7.40	5.00	5.50	6.00	6.50	22.75	33.69	48.60	63.26

Other Greenhouse Emissions Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Open Solicitation												
Photovoltaic Systems R&D												
Power Systems Integration												
Solar Buildings												
Solar International												
Solar Thermal												
Wind Energy R&D												
OPT Other Greenhouse Emissions Displaced Total												

SO2 Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D				0					0	0	0	0
Energy Storage												
Geothermal Energy R&D				0					0	0	0	0
High Temperature Superconductivity				0					0	0	0	0
Hydrogen				0					0	0	0	0
Hydropower				0					0	0	0	0
Open Solicitation												
Photovoltaic Systems R&D				0					0	0	0	0
Power Systems Integration												
Solar Buildings												
Solar International												
Solar Thermal				0					0	0	0	0
Wind Energy R&D				0					0	0	0	0
OPT SO2 Displaced Total				0					0	0	0	0

NOX Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D				0					0	0	0	0
Energy Storage												
Geothermal Energy R&D				0					0	0	0	0
High Temperature Superconductivity				0					0	0	0	0
Hydrogen				0					0	0	0	0
Hydropower				0.01					0	0	0	0
Open Solicitation												
Photovoltaic Systems R&D				0					0	0	0	0
Power Systems Integration												
Solar Buildings												
Solar International												
Solar Thermal				0					0	0	0	0
Wind Energy R&D				0					0	0	0	0
OPT NOX Displaced Total				0.01					0	0	0	0

Particulates Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Open Solicitation												
Photovoltaic Systems R&D												
Power Systems Integration												
Solar Buildings												
Solar International												
Solar Thermal												
Wind Energy R&D												
OPT Particulates Displaced Total												

VOCs Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D				0					0	0	0	0
Energy Storage												
Geothermal Energy R&D				0					0	0	0	0
High Temperature Superconductivity				0					0	0	0	0
Hydrogen				0					0	0	0	0
Hydropower				0					0	0	0	0
Open Solicitation												
Photovoltaic Systems R&D				0					0	0	0	0
Power Systems Integration												
Solar Buildings												
Solar International												
Solar Thermal				0					0	0	0	0
Wind Energy R&D				0					0	0	0	0
OPT VOCs Displaced Total				0					0	0	0	0

HCs Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Open Solicitation												
Photovoltaic Systems R&D												
Power Systems Integration												
Solar Buildings												
Solar International												
Solar Thermal												
Wind Energy R&D												
OPT HCs Displaced Total												

Other Environmental Benefits (Thousand Tons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D												
Energy Storage												
Geothermal Energy R&D												
High Temperature Superconductivity												
Hydrogen												
Hydropower												
Open Solicitation												
Photovoltaic Systems R&D												
Power Systems Integration												
Solar Buildings												
Solar International												
Solar Thermal												
Wind Energy R&D												
OPT Other Environmental Benefits Total												

PM10 Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Biomass Power R&D				0					0	0	0	0
Energy Storage												
Geothermal Energy R&D				0					0	0	0	0
High Temperature Superconductivity				0					0	0	0	0
Hydrogen				0					0	0	0	0
Hydropower				0					0	0	0	0
Open Solicitation												
Photovoltaic Systems R&D				0					0	0	0	0
Power Systems Integration												
Solar Buildings												
Solar International												
Solar Thermal				0					0	0	0	0
Wind Energy R&D				0					0	0	0	0
OPT PM10 Displaced Total				0					0	0	0	0

Office of Transportation Technologies (OTT)

Resource

DOE Funding Level (Millions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies												
Biofuels		$30.68	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00
Fuels Utilization												
Heavy Duty Vehicle Technologies		$1.70	$25.20	$26.00	$35.00	$40.00	$40.00		$40.00	$25.00	$22.00	$15.00
Technology Deployment												
Transportation Materials Technologies												
OTT DOE Funding Level Total		$32.38	$55.20	$56.00	$65.00	$70.00	$70.00	$30.00	$70.00	$55.00	$52.00	$45.00

Research (%)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Biofuels	0%	45.00%	45.00%	45.00%	45.00%	45.00%	45.00%	45.00%	45.00%	45.00%	45.00%	45.00%
Fuels Utilization	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Heavy Duty Vehicle Technologies	0%	30.00%	25.00%	25.00%	20.00%	20.00%	20.00%	20.00%	30.00%	35.00%	50.00%	55.00%
Technology Deployment	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Transportation Materials Technologies	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Development (%)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Biofuels	0%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%
Fuels Utilization	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Heavy Duty Vehicle Technologies	0%	40.00%	45.00%	55.00%	60.00%	60.00%	55.00%	55.00%	50.00%	50.00%	40.00%	35.00%
Technology Deployment	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Transportation Materials Technologies	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Deployment (%)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Biofuels	0%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%
Fuels Utilization	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Heavy Duty Vehicle Technologies	0%	30.00%	30.00%	20.00%	20.00%	20.00%	25.00%	25.00%	20.00%	15.00%	10.00%	10.00%
Technology Deployment	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Transportation Materials Technologies	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Partner Financial Investment (Millions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies												
Biofuels	$8.00	$7.00	$7.00	$7.00	$8.00	$8.00	$8.00	$8.00	$9.00	$10.00	$10.00	$10.00
Fuels Utilization												
Heavy Duty Vehicle Technologies	$2.00	$3.00	$3.50	$4.00	$4.00	$9.00						
Technology Deployment												
Transportation Materials Technologies												
OTT Partner Financial Investment Total	$10.00	$10.00	$10.50	$11.00	$12.00	$17.00	$8.00	$8.00	$9.00	$10.00	$10.00	$10.00

Partner Non-Financial Investment (Millions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies												
Biofuels	$2.00	$3.00	$3.00	$3.00	$4.00	$4.00	$4.00	$4.00	$5.00	$6.00	$6.00	$6.00
Fuels Utilization												
Heavy Duty Vehicle Technologies		$5.00	$6.00	$10.00	$12.00	$15.00						
Technology Deployment												
Transportation Materials Technologies												
OTT Partner Non-Financial Investment Total	$2.00	$8.00	$9.00	$13.00	$16.00	$19.00	$4.00	$4.00	$5.00	$6.00	$6.00	$6.00

Partners (Number)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies												
Biofuels		6.00	6.00	6.00	7.00	7.00	7.00	7.00	8.00	9.00	9.00	9.00
Fuels Utilization												
Heavy Duty Vehicle Technologies		24.00	27.00	27.00	28.00	28.00						
Technology Deployment												
Transportation Materials Technologies												
OTT Partners Total		30.00	33.00	33.00	35.00	35.00	7.00	7.00	8.00	9.00	9.00	9.00

Energy

Total Primary Energy Displaced (Trillion Btu)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies			0	0	0	0	3.03	28.12	32.00	637.75	1,214.91	1,589.99
Biofuels				0.01	0.08	2.79	5.39	10.46	54.16	359.78	787.74	1,000.64
Fuels Utilization												
Heavy Duty Vehicle Technologies		0	1.99	7.47	13.31	20.08	31.25	46.19	64.85	205.28	313.14	396.26
Technology Deployment				0					0	0	0	0
Transportation Materials Technologies			0	0	0	0	0.04	0.29	0.76	11.87	31.69	49.66
OTT Total Primary Energy Displaced Total		0	1.99	7.48	13.39	22.87	39.71	85.06	151.77	1,214.68	2,347.48	3,036.55

Direct Electricity Displaced (Billion Kilowatthours)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies							(0.03)	(0.26)	(0.73)	(5.47)	(8.88)	(9.82)
Biofuels												
Fuels Utilization												
Heavy Duty Vehicle Technologies												
Technology Deployment												
Transportation Materials Technologies								(0.02)	(0.07)	(0.53)	(0.86)	(0.95)
OTT Direct Electricity Displaced Total							(0.03)	(0.28)	(0.80)	(6.00)	(9.74)	(10.77)

Direct Natural Gas Displaced (Billion Cubic Feet)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies												
Biofuels												
Fuels Utilization			0	0	0	0	0	0	0	0	0	0
Heavy Duty Vehicle Technologies			(2.35)	(2.36)	(2.31)	(2.15)	(1.94)	(1.71)	(1.48)	(0.44)	(0.14)	
Technology Deployment				(1.08)	(9.21)	(22.76)	(42.78)	(64.70)	(89.34)	(179.54)	(204.21)	(195.74)
Transportation Materials Technologies												
OTT Direct Natural Gas Displaced Total			(2.35)	(3.44)	(11.52)	(24.91)	(44.72)	(66.41)	(90.82)	(179.98)	(204.35)	(195.74)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Direct Petroleum Displaced (Million Barrels)												
Advanced Automotive Technologies			0.34	0.52	0.87	1.24	3.99	10.77	22.67	135.07	246.14	316.60
Biofuels					0.14	0.48	0.93	1.80	9.34	62.03	135.82	172.54
Fuels Utilization				0	0	0	0	0	0	0	0	0
Heavy Duty Vehicle Technologies			0.34	1.29	2.29	3.46	5.39	7.96	11.18	35.39	53.99	68.32
Technology Deployment				0.19	1.64	4.05	7.61	11.50	15.88	31.92	36.46	34.80
Transportation Materials Technologies			0.03	0.05	0.08	0.12	0.34	0.62	0.97	4.47	9.00	12.66
OTT Direct Petroleum Displaced Total			0.72	2.05	5.02	9.34	18.25	32.65	60.04	268.88	481.41	604.92
Direct Coal Displaced (Million Short Tons)												
Advanced Automotive Technologies												
Biofuels												
Fuels Utilization												
Heavy Duty Vehicle Technologies												
Technology Deployment												
Transportation Materials Technologies												
OTT Direct Coal Displaced Total												

Financial

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Energy Costs or Savings (Billions of $'s)												
Advanced Automotive Technologies							$0.01	$0.23	$0.73	$6.11	$12.03	$15.71
Biofuels									($0.01)		$0.07	$0.07
Fuels Utilization												
Heavy Duty Vehicle Technologies			$0.02	$0.07	$0.12	$0.18	$0.31	$0.49	$0.73	$2.75	$4.17	$5.05
Technology Deployment			$0.06	$0.13	$0.23	$0.35	$0.49	$0.60	$0.71	$0.85	$0.83	$0.70
Transportation Materials Technologies								$0.01	$0.01	$0.16	$0.39	$0.58
OTT Energy Costs or Savings Total			$0.08	$0.20	$0.35	$0.53	$0.81	$1.32	$2.19	$9.87	$17.49	$22.12

Non-Energy Savings or Costs (Billions of $'s)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies							$0.31	$2.21	$4.50	$9.25	$10.33	$10.22
Biofuels							($0.01)	($0.04)	($0.12)	($0.71)	($1.74)	($1.86)
Fuels Utilization												
Heavy Duty Vehicle Technologies			$0.02	$0.04	$0.03	$0.01	($0.01)	$0.02	$0.03	($0.12)	($0.37)	($0.54)
Technology Deployment			($0.01)	$0.01	$0.14	$0.19	$0.20	$0.15	($0.02)	($0.54)	($0.89)	($0.89)
Transportation Materials Technologies							$0.01	$0.07	$0.12	$0.34	$0.44	$0.43
OTT Non-Energy Savings or Costs Total			$0.01	$0.05	$0.16	$0.20	$0.51	$2.40	$4.51	$8.23	$7.77	$7.37

Environmental

CO Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies							0	0.03	0.10	0.82	2.08	3.21
Biofuels								0.05	0.09	0.48	1.13	1.11
Fuels Utilization												
Heavy Duty Vehicle Technologies			0.53	1.67	3.45	6.00	9.39	13.59	18.71	54.27	88.52	106.28
Technology Deployment					0	0.01	0.02	0.04	0.05	0.14	0.19	0.19
Transportation Materials Technologies									0	0.01	0.04	0.10
OTT CO Displaced Total			0.53	1.67	3.46	6.01	9.41	13.70	18.95	55.72	91.96	110.88

Carbon Equivalent Emissions Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies			0	0	0	(0.01)	(0.03)	0.31	1.11	10.00	20.16	27.19
Biofuels				0	0.01	0.05	0.10	0.20	1.02	6.77	14.83	18.84
Fuels Utilization												
Heavy Duty Vehicle Technologies			0.05	0.18	0.30	0.44	0.66	0.94	1.29	3.87	5.87	7.48
Technology Deployment			0.17	0.27	0.43	0.62	0.83	1.04	1.24	1.82	1.98	1.94
Transportation Materials Technologies				0		0	0	0.01	0.02	0.25	0.66	1.03
OTT Carbon Equivalent Emissions Displaced Total			0.22	0.44	0.75	1.11	1.57	2.49	4.68	22.71	43.50	56.48

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Other Greenhouse Emissions Displaced (MMTons)												
Advanced Automotive Technologies												
Biofuels												
Fuels Utilization												
Heavy Duty Vehicle Technologies												
Technology Deployment												
Transportation Materials Technologies												
OTT Other Greenhouse Emissions Displaced Total												
SO2 Displaced (MMTons)												
Advanced Automotive Technologies												
Biofuels												
Fuels Utilization												
Heavy Duty Vehicle Technologies												
Technology Deployment												
Transportation Materials Technologies												
OTT SO2 Displaced Total												
NOX Displaced (MMTons)												
Advanced Automotive Technologies								0	0	0.03	0.07	0.10
Biofuels								0	0.01	0.03	0.05	0.06
Fuels Utilization												
Heavy Duty Vehicle Technologies			0.50	1.55	3.22	5.58	8.74	12.68	17.47	50.23	82.06	100.40
Technology Deployment												
Transportation Materials Technologies										0	0	0.01
OTT NOX Displaced Total			0.50	1.55	3.22	5.58	8.74	12.68	17.47	50.29	82.18	100.57
Particulates Displaced (MMTons)												
Advanced Automotive Technologies												
Biofuels												
Fuels Utilization												
Heavy Duty Vehicle Technologies												
Technology Deployment												
Transportation Materials Technologies												
OTT Particulates Displaced Total												

VOCs Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies												
Biofuels												
Fuels Utilization												
Heavy Duty Vehicle Technologies												
Technology Deployment												
Transportation Materials Technologies												
OTT VOCs Displaced Total												

HCs Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies						0.49	2.35	9.85	23.63	154.82	361.41	506.97
Biofuels								0	0	0.02	0.09	0.06
Fuels Utilization												
Heavy Duty Vehicle Technologies			0.14	0.44	0.92	1.60	2.50	3.62	4.99	14.66	24.60	31.51
Technology Deployment				0	0.01	0.02	0.04	0.05	0.07	0.19	0.26	0.26
Transportation Materials Technologies										0	0	0.01
OTT HCs Displaced Total			0.14	0.44	0.92	2.10	4.88	13.53	28.70	169.69	386.37	538.82

Other Environmental Benefits (Thousand Tons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies												
Biofuels												
Fuels Utilization												
Heavy Duty Vehicle Technologies												
Technology Deployment												
Transportation Materials Technologies												
OTT Other Environmental Benefits Total												

PM10 Displaced (MMTons)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010	2015	2020
Advanced Automotive Technologies												
Biofuels												
Fuels Utilization												
Heavy Duty Vehicle Technologies												
Technology Deployment												
Transportation Materials Technologies												
OTT PM10 Displaced Total												

Appendix D

Report on Integrated Modeling for GPRA 2000

INTEGRATED MODELING FOR GPRA 2000

OVERVIEW

We have conducted an integrated assessment of the impact of the Office of Energy Efficiency and Renewable Energy (EE) programs as part of EE's GPRA analysis. The purpose of this assessment is to analyze EE's programs in a consistent economic framework and to account for the interactive effects among the various programs. Each of the sector offices performs an independent estimate of the savings for their programs, but these cannot be simply summed to create a value for all of EE. There will be feedback and interactive effects resulting from (1) changes in energy prices resulting from lower energy consumption and (2) the interaction between programs affecting the mix of generation sources and those affecting the demand for electricity.

The National Energy Modeling System (NEMS) was used this year for the first time as the integrated model. The Annual Energy Outlook 1998 (AEO98) version was used as the starting point. We then made several changes to the model to enhance its ability to represent the EE programs. The most significant change was the addition of an endogenous building shell efficiency component. In addition, several of the modules were altered to allow for technology characteristics and other parameters to be specified by the user. The modified version of the model is referred to here as NEMS*.

The No EE Case

The baseline forecast, called the No EE Case, is a projection meant to represent the future U.S. energy system without the effect of continued EE programs. The idea is to remove any effects of EE programs that are already included in the AEO98 Reference Case in order to avoid double counting energy consumption reductions. As recommended by the various EE sector offices, we made the following modifications for the No EE Case. For the transportation sector, we assumed that no alternative fuel vehicles would be purchased except those mandated in California. Similarly, in the utility sector, we assumed that there would be no new renewable capacity constructed except as part of state set-asides as represented in the AEO. As will be discussed in the buildings section, the No EE Case includes the modified shell efficiency structure and assumes that part of the shell efficiency improvement in the Residential sector in the AEO98 is attributable to EE programs. No changes were made to the industrial sector for the No EE Case. See Appendix A for the No EE Case projected energy consumption by sector and fuel.

Representation of EE Programs

After the No EE Case was established, the EE programs were represented in the various NEMS* modules. Each sector was treated separately to derive estimated energy savings without the interaction of the other sectors' programs[1]. We received the inputs for the programs from the sector offices and their contractors. To the maximum extent possible, we represented the programs through their impacts on technology characteristics and allowed NEMS* to project the market penetration and savings resulting from their development. In some cases, where the model had insufficient representation, we based our projections on the program office penetration estimates and simply used NEMS* as an accounting tool. A major exception is the treatment of the industrial

[1] The modeling of the individual demand models was done using PC stand-alone versions of the module that speed the run time and facilitate data changes.

sector. The OIT programs and technologies are very specialized and beyond the capability of the model to represent. For this sector we simply input estimated energy savings.

Energy savings were estimated at the planning unit level for each sector, except for industry. In this step, the primary savings for electricity were computed using the heat rates supplied in the GPRA assumptions. The use of the GRPA specified heat rate makes the savings more directly comparable to the sectors' estimates than they were last year when the electricity savings were those calculated by the model. This year the integration with electricity is kept separate and is introduced as part of the integration effect. Preliminary comparison tables were shared with EE, and minor modeling adjustments were made based on their comments. The revised tables are shown in the sector descriptions below.

The full NEMS* model was then run for each of the sector office programs individually. In these scenarios the energy savings include the effect that a single sector's programs have on fuel consumption in other sectors. For example, reductions in energy usage generally lead to lower energy prices, which may stimulate additional demand, both in the sector that is being analyzed and in all other sectors. The primary energy associated with reduced electricity generation is calculated endogenously within the electricity module. In addition, reductions in oil and gas use affect the energy required for petroleum refining, lease and plant fuel, and pipeline gas consumption.

Next, the model was run with all the programs in all the sectors to derive the Full EE Case. The total primary energy savings (fossil savings because renewables are not included) and carbon savings were then allocated to the individual sectors. Because the total savings were not equal to the sum of the individual sectors, they were allocated to the sectors based on the single-sector integrated savings estimates. In the individual sector tables, the "integrated effect" reported is the difference between the stand-alone results (no price or other feedback) and the scaled totals for the Full EE Case[2].

Integrated Modeling Projected Savings

Table 1 shows the final aggregate results for primary energy, and Table 2 shows the carbon emission reductions. The EE sector office results, shown for comparison purposes, are from the GPRA database as of 12/7/98 with two exceptions. The OUT results were modified based on the ADL review of several planning units, and revised results were provided directly by OTT. In general the integrated savings are roughly 50-70 percent of the sector estimates. Greater detail for each sector is presented in the sections following.

[2] Note that this is slightly different from last year when the planning unit savings were partially integrated cases including price and other feedback associated with each sector's programs.

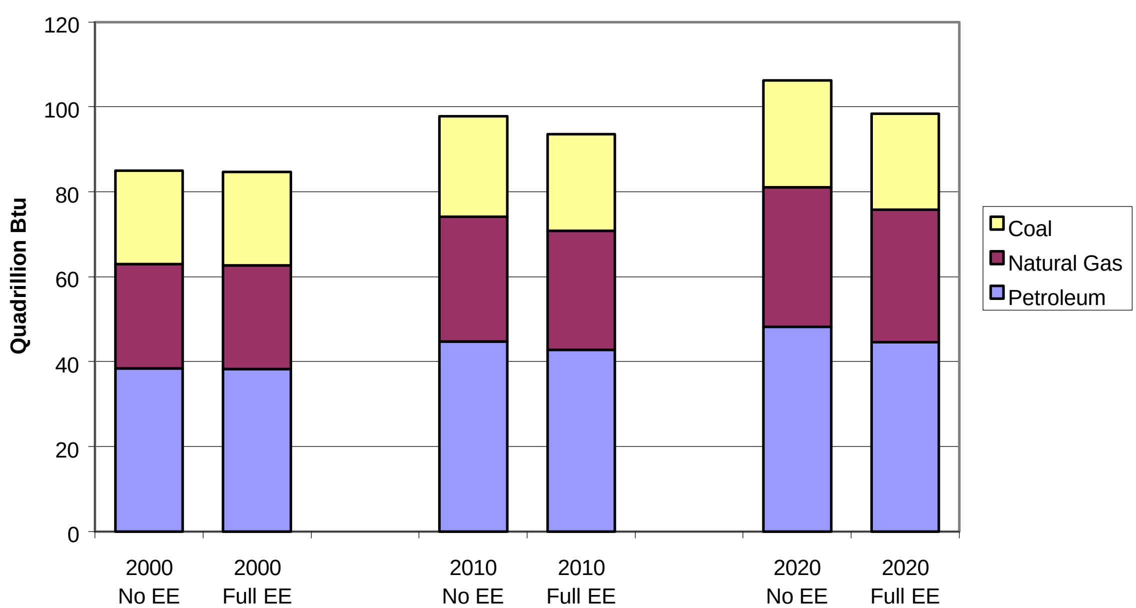
Table 1: Total Fossil Energy Savings Projections (Quadrillion Btu/Year)										
Year	**OBT**		**OIT**		**OTT**		**OUT**		**Totals**	
	Intgtd. Results	**Sector Results**	**Intgtd. Results**	**Sector Results**	**Intgtd. Results**	**Sector Results**	**Intgtd. Results**	**Sector Results**	**Intgtd. Results**	**Sector Results**
2000	0.09	0.06	0.13	0.22	0.07	0.01	0.00	0.22	0.28	0.51
2010	1.35	2.12	0.84	1.22	0.96	1.21	0.70	1.18	3.85	5.74
2020	2.43	5.24	2.05	3.12	1.66	2.87	1.35	3.32	7.48	14.55

Table 2: Total Carbon Equivalent Emissions Savings (Million Metric Tons of Carbon/Year)										
Year	**OBT**		**OIT**		**OTT**		**OUT**		**Totals**	
	Intgtd. Results	**Sector Results**	**Intgtd. Results**	**Sector Results**	**Intgtd. Results**	**Sector Results**	**Intgtd. Results**	**Sector Results**	**Intgtd. Results**	**Sector Results**
2000	1.4	1.2	2.6	4.1	1.4	0.4	-0.1	4.5	5.3	10.2
2010	25.3	33.4	16.7	23.3	14.9	24.8	14.9	23.2	71.9	104.7
2020	51.9	77.1	43.6	58.7	20.6	59.6	33.2	57.2	149.3	252.5

Figure 1 illustrates the projected primary fossil energy consumption under the two scenarios. The savings in 2020 represent 7 percent of the projected base consumption.

Figure 1

Primary Fossil Energy Consumption



BUILDINGS SECTOR

Shell Technology Representation

Many programs of the Office of Building Technology State, and Community Programs (BTS) affect the shell efficiency of buildings, so it was important to have a mechanism for representing shell technologies in the NEMS* building modules. The AEO98 version of the model represents the shell efficiencies through user defined indices which are then adjusted based on energy prices. Therefore as part of this analysis, we have created a new structure that performs an economic comparison of various shell technology measures. The BTS envelope technologies could then be represented directly in the model and the adoption rates endogenously determined.

The No EE Case

In the No EE Case, as in the AEO98, most delivered energy prices are projected to increase only slightly or to decline. As a result, very little shell improvements are projected based on price. In the residential model, the AEO includes a factor for technological change which leads to improved efficiencies over time. We included the same factors in our No EE Case (and all other cases) in order to be consistent. The resulting No EE Case shell indices are similar but slightly higher (less efficient) than that projected in the AEO98 for both residential and commercial buildings. One could attribute this difference to EIA including some of the effect of EE programs, particularly building codes, in the AEO98. No additional changes were made from the AEO98 baseline to represent the No EE Case.

Representation of the BTS Programs

The data for the planning units was provided by the Pacific Northwest National Laboratory (PNNL). Most of the BTS planning units were represented in the residential and the commercial NEMS* modules by changing the cost and/or efficiency characteristics of equipment or shell technologies. Programs with no incremental costs, such as the Community Partnership Program, cannot be modeled as a technology choice. For these programs we performed an off-line analysis based on the BTS penetration rates to compute a target savings. These savings were achieved in NEMS* by lowering the consumer hurdle rates for the appropriate end-uses.

There are two planning units, State Grants and Technology Roadmaps, which we did not model, because they are general programs that are not tied to specific technologies or end-uses. We also were unable to model fuel cells micro-cogeneration because of its complex end-use linkages.

Model Scenarios and Results

A scenario was run for each planning unit individually using only the Residential and Commercial modules without the other NEMS* modules. For this computation of savings, delivered electricity was converted to primary using the GPRA Data Call values in order to make the results comparable to the BTS estimated savings. Next an All BTS program was created where all the planning units were included. The savings in this case were slightly lower than the sum of the individual planning unit savings because of interaction among the programs. For example, building codes raise the overall shell efficiency of new buildings which means that the introduction of new equipment produces smaller savings. In Table 3 below, the estimated savings per planning unit have been scaled so that the sum matches the All BTS program case.

For most of the planning units our savings estimates are roughly 50 percent of the BTS estimate. In most cases this is the result of lower penetration rates predicted based on the economic framework of NEMS*. In the case of appliance standards there also appears to be differing assumptions about the base use of appliances in the absence of standards. The Energy Star values are lower in part because of an allocation difference. For those technologies where there are both a standard and an Energy Star program, we have allocated to the Energy Star program only the savings above those produced by the standards, whereas BTS allocates a portion of the standards savings to the Energy Star program.

The integrated effect is calculated by running two additional sets of runs. The first includes running the BTS programs in NEMS* with all the other modules on but not including the other EE programs. This scenario captures the feedback effects of changing prices due to the energy consumption reductions in buildings, the primary energy associated with electricity reductions, and any changes associated with oil and gas production and transportation. The second case is the Full EE Case with all the EE programs included which produces the total primary savings across the economy. Scaling the individual sector savings to the Full EE total produces the bottom line savings for each sector. Thus the integrated effect includes the interaction of buildings with other parts of the energy system and with other EE programs. The integrated savings are positive principally because of an increase in the primary energy savings associated with the electricity demand reductions. The NEMS* model produced a higher marginal heat rate than that specified in the GRPA Data Call, which assumed that the heat rate would decline over time as new combined cycles were displaced. In the integrated cases, there is a slightly greater mix of coal compared to gas savings for electricity generation because of lower oil and gas prices resulting from lower buildings energy consumption. Coal-fired generation has a higher heat rate than does generation from gas combined cycles. There is also a slight increase in savings from pipeline gas use and petroleum refining. These increases more than offset the slight reduction in other savings due to lower energy prices.

Table 3: Energy Savings by BTS Planning Units (Quadrillion Btu)

	2000		2010		2020	
	NEMS* Results	**BTS Results**	**NEMS* Results**	**BTS Results**	**NEMS* Results**	**BTS Results**
Weatherization Assistance	0.01	0.01	0.08	0.10	0.15	0.18
Community Partnerships	0.00	0.01	0.13	0.22	0.26	0.42
Energy Star	0.00	0.00	0.03	0.09	0.04	0.18
Residential Buildings Integration	0.00	0.00	0.12	0.13	0.24	0.32
Commercial Buildings Integration	0.00	0.01	0.13	0.20	0.32	0.53
Equipment, Materials & Tools	0.05	0.03	0.78	1.26	1.23	3.23
State Energy Program		0.01		0.06		0.10
Technology Roadmaps		0.00		0.08		0.28
Subtotal	0.06	0.06	1.27	2.12	2.24	5.24
Integration Effect	0.03		0.08		0.18	
Total Fossil Energy Savings	0.09		1.35		2.43	

Note the shaded areas indicate planning units not modeled in NEMS*.

INDUSTRY

Because the industrial sector of NEMS* is not well suited to representing specific alternative technologies, we have not attempted to model individual planning units for this sector. Instead we created a target level of savings based on the Office of Industrial Technology's (OIT's) estimate and the relationship of the integrated savings with the sector estimates for the other sectors. In consultation with the Office of Budget, Planning, and Customer Service (OBPCS) and NREL, the savings target was set so that the ratio of the non-integrated NEMS* industrial savings to OIT's estimates would be the roughly the same as the average ratio of NEMS* estimates for BTS, OTT and OUT compared to the EE sector office estimates. This ratio was roughly 60 percent. The fossil and electricity sector savings are simply subtracted from the projected energy derived endogenously.

Scenarios and Results

As for the other sectors, the industrial module of NEMS* was first run by itself with the targeted savings. The electricity savings are input as billion kilowatt-hours and are accounted for on a primary basis in Table 4 using the GPRA heat rates to make the conversion. Next, the whole NEMS* model was run with the OIT savings to include the price and other sector feedback effects and an endogenous primary electricity calculation. In the table below the first subtotals are the stand-alone savings without any feedback, while the final savings are the scaled integrated savings. Similar to the BTS results, the integrated savings are positive because of the higher primary electricity conversion produced by NEMS* compared to the values in the GPRA Data Call. This more than offsets a slight reduction in other savings due to lower energy prices.

Table 4: Energy Savings by OIT Planning Units (Quadrillion Btu)

	2000		2010		2020	
	NEMS* Results	OIT Results	NEMS* Results	OIT Results	NEMS* Results	OIT Results
Advanced Materials & CFCC's		0.00		0.23		0.55
Aluminum Vision		0.00		0.04		0.16
Chemicals Vision		0.00		0.15		0.83
Cogeneration		0.00		0.20		0.44
Forest & Paper Products Vision		0.00		0.05		0.21
Glass Vision		0.00		0.04		0.07
IAC's		0.06		0.08		0.09
Integrated Delivery Program		0.03		0.16		0.33
Inventions & Innovations		0.11		0.11		0.12
Metal Casting Vision		0.00		0.03		0.09
NICE-3		0.02		0.11		0.14
Steel Vision		0.00		0.04		0.11
Subtotal	0.11	0.22	0.74	1.22	1.84	3.12
Integration Effect**	0.02		0.10		0.21	
Total Fossil Energy Savings	0.13		0.84		2.05	

TRANSPORTATION

No EE Case

For the No EE case, we assumed that there would be no penetration of alternative fuel vehicles (AFVs) except those mandated by California legislation. This was accomplished by changing the year of commercially availability for AFVs. The EPACT AFV sales were also explicitly removed for the scenario, because they are represented in the Office of Transportation Technologies (OTT) programs.

Representation of OTT programs

A variety of programs were added either with coding changes or with changed and/or added input files to produce the All OTT case.

EPACT Mandates. The EPACT mandates were added at the level of the AEO98.

AFV Program Attributes. Data was provided by OTT on AFV attributes relative to conventional gasoline vehicles, that included vehicle price, vehicle range, and vehicle efficiency (MPG equivalent). These attributes were substituted for those that were used in AEO98. In addition, a variety of AFVs that were included in AEO98 are not included in the OTT data, so they are excluded from the model. This included LPG AFVs that are included in NEMS but not in the OTT programs. One of the OTT technologies, direct injection gasoline (SDI), was not in NEMS. The "slot" for gas turbines was used to model SDI, using the OTT attributes.

AFV Commercial Availability. The commercial availabilities for the AFVs that are included in the OTT programs were changed to be consistent with the data provided by OTT. The model uses a variable that gives the year for 50 percent commercial availability with an "s-curve" penetration around this center. Most of the penetration occurs in 3 to 4 years, so the 50 percent point was set 3 years beyond the year in the OTT data. In addition, the AFV shares were allowed to change beginning in 1998, rather than in 2003 which was the default.

Equation Constants for Modeling AFVs. The forecasted results for shares of light duty vehicles are very sensitive to the basic assumptions regarding consumer behavior and the future "view of the world" as evidenced through the values for the constant coefficients in the AFV share equations. We have changed these assumptions from those that are in the base case NEMS to reflect OTT's view, which leads to more optimistic results with respect to the acceptance of alternate fuel and diesel vehicles. These coefficients are used at each stage of the nested logit process for vehicle market shares. The first stage competes two electricity AFVs, the second stage competes an electricity prototype with the other AFVs, and the final stage competes an AFV prototype with gasoline and diesel. All of these coefficients were set to zero except for electricity. The two electricity constants were set to a small value of 0.5 to make up for the bias against them in the nested logit.

Ethanol Price. The ethanol price in the base case AEO was multiplied by a factor so that the resulting prices were similar to those used by OTT[3]. This factor decreased over time to about 60 percent in 2020.

[3] The ethanol price used was from the 1999 GPRA that we were assured was close to that used for the 2000 GPRA.

Heavy Vehicle Program Attributes. The modeling methodology used in the freight model does not compete various alternate fueled vehicles against each other, but instead attempts to model the penetration of various technologies. As a consequence it was not possible to compete AFVs using OTT attributes. However, several technologies in the input file are not used, so one of the "slots" was manipulated to model the penetration of advanced diesel technologies. The savings were taken from the OTT program attributes[4], and an assumption was made about the penetration rate.

Materials Substitution. The transportation model has four levels of materials technologies for light cars and trucks that penetrate at different times. In a preliminary analysis, we changed these so that their time of penetration was accelerated. The savings for AFVs was about two-thirds of the OTT program savings estimate. However we have not included this in our final results because of the arbitrary nature of its implementation.

Scenarios and Results

Various scenarios were run in order to allocate the savings to the individual planning units. These included scenarios for No EE, for EPACT, for advanced diesel, for heavy vehicles, and for other programs combined. Savings for the combined programs were allocated based upon the marginal vehicle miles traveled (VMT) and the specific characteristics of each program. Table 5 and Table 6 show the level of oil and primary fossil energy savings for each program unit. The overall results for direct oil savings in 2020 are similar to those estimated by OTT, but the allocation to program units differs somewhat. We projected lower savings in advanced automobile technologies and more in the other program units. We also have a somewhat different rate of penetration over time for most of the program units. The overall results for fossil savings in 2020 are further apart, due in large part to the different composition of underlying pieces in the biofuels program, and to lesser differences in other programs. It may be that we have accounted for methanol as a fossil based fuel while OTT has treated it as a renewable fuel.

As for the other sectors, the integrated effect is calculated by running two additional sets of cases. The first includes running the OTT programs in NEMS* with all the other modules on but not including the other EE programs. This scenario captures the feedback effects of changing prices due to energy consumption reductions, the primary energy associated with electricity reductions, and any changes associated with oil and gas production and transportation. The second run is a Full EE Case with all the EE programs included which produces the total primary savings across the economy. In these scenarios the gasoline and distillate prices are lower than in the No EE Case (because of the lower consumption of gasoline and distillate with the OTT programs), and the ethanol and methanol prices are significantly higher by 2020. This price effect erodes the savings from the OTT programs but is partially offset by savings in the petroleum refining sector. The net result is that integrated petroleum savings in 2020 are about 0.9 quads lower than in the standalone case.

Integration also reduces the fossil energy savings, again primarily by reducing the shift from oil to alternative fuel vehicles as energy prices are changed. For this sector the primary energy associated with electricity production creates a negative integration effect, because electricity demand is higher with OTT programs. The difference in the marginal electric heat rate compared to the GPRA assumptions is more pronounced for this sector. The increased usage of natural gas in vehicles leads to higher gas prices and therefore lower gas consumption in the utility sector. In addition the

[4] Again we used the 1999 GRPA value.

electric vehicles are assumed to recharge at night, which means that they displace coal-fired rather than gas-fired generation. Both of these effects lead to greater coal and less natural gas generation and therefore a higher heat rate. The primary energy savings from petroleum refining partially offset these effects.

Table 5: Oil Savings by OTT Planning Units (Quadrillion Btu)

	2000		2010		2020	
	NEMS* Results	**OTT Results**	**NEMS* Results**	**OTT Results**	**NEMS* Results**	**OTT Results**
Technology Deployment	0.07	0.07	0.54	0.41	0.75	0.44
Biofuels	0.04	0.00	0.72	0.36	1.31	1.00
Advanced Automotive Technologies	0.00	0.00	0.58	0.78	1.20	1.84
Advanced Heavy Vehicle Technologies	0.00	0.01	0.12	0.21	0.65	0.40
Materials Technologies	0.00	0.00	0.00	0.03	0.00	0.07
Subtotal	0.11	0.08	1.97	1.79	3.91	3.75
Integration Effect	0.02		-0.34		-0.88	
Total Petroleum Savings	0.13		1.62		3.03	

Table 6: Primary Fossil Energy Savings by OTT Planning Units (Quadrillion Btu)

	2000		2010		2020	
	NEMS* Results	**OTT Results**	**NEMS* Results**	**OTT Results**	**NEMS* Results**	**OTT Results**
Technology Deployment	0.01	0.00	0.15	0.00	0.20	0.00
Biofuels	0.01	0.00	0.30	0.36	0.59	1.00
Advanced Automotive Technologies	0.00	0.00	0.38	0.64	0.79	1.59
Advanced Heavy Vehicle Technologies	0.00	0.01	0.12	0.20	0.65	0.23
Materials Technologies	0.00	0.00	0.00	0.01	0.00	0.05
Subtotal	0.04	0.01	0.95	1.21	2.23	2.87
Integration Effect	0.04		0.01		-0.56	
Total Fossil Savings	0.07		0.96		1.66	

The change in the mix of fuels used to generate electricity also has a large impact on carbon emission savings. As a result, the NEMS* carbon savings estimates for OTT (as shown in Table 2) are proportionally lower than the fossil energy savings compared to OTT's estimates. The shift from gas to coal in electricity generation has significant carbon implications because coal has almost twice the carbon content of gas. In addition to the shifts caused by higher gas prices and baseload recharging of electric vehicles, lower oil prices lead to a shift in dual-fuel oil and gas generating units to greater use of oil.

The NEMS* projections of natural gas prices and expected future prices used by the electricity sector appear to be very sensitive to levels of gas consumption and production. To gauge the impact of the gas price effect, we performed a sensitivity case of the OTT programs without the CNG vehicles. The shift generation from natural gas to coal still occurred but was significantly less compared to the all OTT program case. As a result, the carbon penalty from electric vehicles was 2.1 MMT lower in 2010 and 5.9 MMT lower in 2020. Because of the inherent uncertainty of the price responsiveness of gas, it might be reasonable to allocate these savings to OTT.

ELECTRICITY GENERATION

The No EE Case

For this case, we have assumed that there are no future renewable capacity additions beyond the state set-asides assumed by EIA in the AEO98[5]. This was implemented by raising the cost of the renewable technologies sufficiently to preclude their construction.

Representation of OUT Programs

The Office of Utility Technologies (OUT) programs can be grouped into four types: renewable generation, high efficiency generation, renewables in buildings, and other. The first of these groups is the largest and the most straightforward to represent in a modeling framework. We have modified NEMS* to have the capability to overwrite the endogenous learning functions for capital costs with user-specified values. Using the OUT technology characteristics supplied by Princeton Economic Research Inc. (PERI), we adjusted the capital costs, O&M costs, capacity factors, and heat rates (where applicable) for the various technologies. The NEMS* model was used to estimate the penetration of the various renewable types and the associated fossil energy savings.

We also made a few code modifications to better represent the biomass planning unit. The gasification biomass technology currently in the AEO98 inadvertently underestimates the operating costs over the lifetime of the plants. This makes the technology overly sensitive to changes in capital costs assumptions. We have corrected this problem. We also made a relatively simple modification to represent biomass co-firing in coal plants, which is not a technology option in the AEO98. Based on the penetration and expected generation from co-fired biomass computed by PERI, we altered the NEMS* plant file to specify that all existing coal plants use a certain percent of biomass as a secondary fuel. In this straightforward approach, no economic analysis is performed[6].

The hydroelectric planning unit is another one that we could not model based on its economics. We added new hydro capacity, equal to the ADL review value for new sites, as unplanned additions. The new hydro was assumed to have the same regional dispersion as the current existing hydro capacity. OUT had also estimated savings from the retention of hydro capacity that was assumed otherwise to be reduced when sites underwent relicensing. After discussions with PERI, we did not attempt to model this portion of the hydro planning unit, because the AEO98 does not assume any loss of capacity due to relicensing.

Three of OUT’s planning units affect buildings: solar buildings, geothermal heat pumps and PVs. We modeled the solar buildings program’s penetration of solar water heaters by specifying a penetration rate in the residential module of NEMS*. We were unable to model the pool heaters. The savings that we derived are smaller that the OUT estimates for the water heater portion, because the NEMS* base usage for electric water heaters was much lower. We did not model

[5] This is the same assumption used in previous years.

[6] The AEO99 will have an economically based biomass co-firing technology, so next year this planning unit can be treated more endogenously.

geothermal heat pumps, because at the time of our analysis it appeared that they would not be included in this year GPRA analysis.

We have not modeled some of the other smaller planning units, because they can not be easily modeled in the NEMS* framework. These include PVs in buildings, energy storage, superconductivity, resource assessment, and open solicitation.

Scenarios and Results

The savings by planning unit in Table 7 were calculated by running the electricity module by itself, without any interaction with the rest of NEMS*. The fossil energy savings are allocated to the individual programs based on the projected increase in generation of each technology. The integration effect and final savings are the result of two additional scenarios: the OUT programs run with the full NEMS* and the Full EE Case with all the EE programs. Because of the feedback of fuel prices, electricity prices, and therefore other sector demands, the savings are lower in the integration case. With all of EE programs, the projected growth in electricity demand is 0.9 percent per year from 2000 to 2020, compared with 1.3 percent in the No EE Case. The lower growth provides less need for new generation sources, which leads to reduced renewable and fuel cell capacity additions. Table 8 shows the table of incremental capacity projections. With the higher demand and base fuel prices, incremental OUT capacity is projected to be 59 GW in 2020. Once the impact of the other EE programs is included, the 2020 capacity increase is only 44 GW. The hydroelectric and biomass capacities are unaffected, because these have been exogenously specified. The primary energy savings associated with fuel cells are lower in NEMS* in the later years, because the model assumes that natural gas continues to be the fuel source. In OUT's analysis there is a shift to 30 percent renewable fuel input by 2020.

Table 7: Energy Savings by OUT Planning Units (Quadrillion Btu)

	2000		2010		2020	
	NEMS* Results	**OUT Results**	**NEMS* Results**	**OUT Results**	**NEMS* Results**	**OUT Results**
Photovoltaics	0.00	0.00	0.00	0.01	0.01	0.05
Fuel cells	0.00	0.00	0.05	0.09	0.51	0.64
Wind	0.00	0.02	0.26	0.16	0.46	0.80
Geothermal (generation only)	0.00	0.10	0.03	0.28	0.09	0.83
Biomass	0.02	0.08	0.35	0.53	0.36	0.67
Solar thermal	0.00	0.00	0.00	0.00	0.01	0.02
Hydropower	0.00	0.01	0.01	0.08	0.03	0.18
Solar buildings	0.00	0.00	0.01	0.03	0.02	0.11
Energy storage		0.00		0.00		0.00
High temp superconductivity		0.00		0.00		0.01
Resource assessment		0.00		0.00		0.01
Open solicitation		0.00		0.00		0.00
Subtotal	0.02	0.22	0.71	1.18	1.48	3.32
Integration Effect	-0.02		-0.01		-0.13	
Total Fossil Energy Savings	0.00		0.70		1.35	

Note the shaded areas indicate planning units not modeled in NEMS*.

Table 8: Incremental Capacity by OUT Planning Units (GW)						
	2000		2010		2020	
	NEMS* Results	OUT Results	NEMS* Results	OUT Results	NEMS* Results	OUT Results
Photovoltaics	0.0	0.0	0.0	0.4	0.4	3.8
Fuel cells	0.0	0.3	3.7	5.4	32.2	28.1
Wind	0.0	0.6	8.1	5.1	17.6	28.2
Geothermal	0.0	0.9	0.4	2.5	1.5	3.9
Biomass	0.3	1.2	5.0	7.5	5.5	10.0
Solar thermal	0.0	0.0	0.0	0.2	0.3	1.2
Hydropower	0.0	0.2	0.3	2.4	1.1	6.1
Total	0.3	3.2	17.5	23.6	58.7	81.2
Integration Effect	0.0		-4.4		-14.8	
Total Integrated	0.3		13.1		43.9	

APPENDIX A – NO EE CASE

N A T I O N A L   E N E R G Y   M O D E L I N G   S Y S T E M
Table 2. Energy Consumption by Sector and Source
(Quadrillion Btu per Year, Unless Otherwise Noted)

Sector and Source	1995	2000	2005	2010	2015	2020
Energy Consumption						
Residential						
Distillate Fuel..............|	0.89	0.86	0.82	0.79	0.78	0.76
Kerosene.....................|	0.07	0.08	0.08	0.07	0.07	0.07
Liquefied Petroleum Gas......|	0.40	0.46	0.48	0.50	0.52	0.53
Petroleum Subtotal.........|	1.36	1.40	1.37	1.37	1.37	1.36
Natural Gas..................|	4.98	5.37	5.52	5.71	5.92	6.10
Coal.........................|	0.05	0.06	0.05	0.05	0.05	0.05
Renewable Energy ....|	0.59	0.61	0.61	0.62	0.63	0.64
Electricity..................|	3.56	3.96	4.29	4.60	4.94	5.27
Delivered Energy...........|	10.54	11.39	11.85	12.35	12.91	13.42
Electricity Related Losses...|	7.88	8.62	8.93	9.28	9.47	9.81
Total......................|	18.42	20.01	20.78	21.63	22.38	23.23
Commercial						
Distillate Fuel..............|	0.47	0.41	0.40	0.39	0.39	0.37
Residual Fuel................|	0.17	0.12	0.12	0.12	0.12	0.12
Kerosene.....................|	0.02	0.02	0.02	0.02	0.02	0.02
Liquefied Petroleum Gas......|	0.07	0.08	0.08	0.09	0.09	0.09
Motor Gasoline ....|	0.08	0.03	0.03	0.03	0.03	0.02
Petroleum Subtotal.........|	0.81	0.65	0.65	0.65	0.65	0.63
Natural Gas..................|	3.11	3.45	3.60	3.74	3.84	3.85
Coal.........................|	0.08	0.09	0.09	0.10	0.10	0.10
Renewable Energy ....|	0.00	0.00	0.00	0.00	0.00	0.00
Electricity..................|	3.26	3.59	3.83	4.08	4.31	4.43
Delivered Energy...........|	7.26	7.78	8.18	8.57	8.90	9.01
Electricity Related Losses...|	7.21	7.81	7.97	8.23	8.27	8.25
Total......................|	14.46	15.60	16.15	16.80	17.17	17.27
Industrial ..						
Distillate Fuel..............|	1.13	1.21	1.35	1.45	1.51	1.56
Liquefied Petroleum Gas......|	2.01	2.14	2.25	2.40	2.45	2.47
Petrochemical Feedstocks.....|	1.23	1.31	1.38	1.47	1.49	1.51
Residual Fuel................|	0.37	0.35	0.35	0.35	0.34	0.35
Motor Gasoline ....|	0.19	0.20	0.23	0.25	0.26	0.27
Other Petroleum ....|	3.77	4.35	4.62	4.89	5.07	5.11
Petroleum Subtotal.........|	8.69	9.55	10.18	10.80	11.12	11.27
Natural Gas ....|	10.05	10.93	11.15	11.65	11.78	11.79
Metallurgical Coal...........|	0.89	0.83	0.76	0.71	0.66	0.61
Steam Coal...................|	1.60	1.56	1.70	1.77	1.78	1.79
Net Coal Coke Imports........|	0.03	0.03	0.05	0.06	0.07	0.08
Coal Subtotal..............|	2.51	2.43	2.51	2.54	2.50	2.48
Renewable Energy ....|	1.74	1.96	2.11	2.25	2.31	2.34
Electricity..................|	3.46	3.70	4.04	4.36	4.56	4.74
Delivered Energy...........|	26.44	28.56	29.98	31.59	32.28	32.62
Electricity Related Losses...|	7.65	8.05	8.41	8.79	8.75	8.83
Total......................|	34.09	36.61	38.39	40.39	41.02	41.44

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N A T I O N A L   E N E R G Y   M O D E L I N G   S Y S T E M

Table 2. Energy Consumption by Sector and Source (continued)

(Quadrillion Btu per Year, Unless Otherwise Noted)

Sector and Source	1995	2000	2005	2010	2015	2020
Transportation						
Distillate Fuel	4.24	5.13	5.62	6.00	6.18	6.29
Jet Fuel	3.13	3.84	4.47	5.22	5.79	6.28
Motor Gasoline	14.65	16.01	17.43	18.68	19.45	20.05
Residual Fuel	0.87	0.94	1.10	1.27	1.42	1.56
Liquefied Petroleum Gas	0.03	0.02	0.02	0.02	0.02	0.02
Other Petroleum	0.28	0.31	0.33	0.35	0.37	0.37
Petroleum Subtotal	23.20	26.24	28.97	31.55	33.22	34.58
Pipeline Fuel Natural Gas	0.72	0.80	0.84	0.95	0.98	1.02
Compressed Natural Gas	0.02	0.02	0.04	0.05	0.07	0.08
Renewables (E85)	0.00	0.00	0.00	0.00	0.00	0.00
Methanol	0.00	0.00	0.00	0.00	0.00	0.00
Liquid Hydrogen	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	0.06	0.06	0.08	0.09	0.10	0.11
Delivered Energy	24.00	27.13	29.93	32.65	34.37	35.80
Electricity Related Losses	0.13	0.14	0.16	0.18	0.20	0.21
Total	24.12	27.27	30.09	32.84	34.57	36.00
Deliver.Energy Cons.All Sectors						
Distillate Fuel	6.73	7.61	8.19	8.64	8.85	8.98
Kerosene	0.11	0.12	0.12	0.12	0.12	0.12
Jet Fuel	3.13	3.84	4.47	5.22	5.79	6.28
Liquefied Petroleum Gas	2.50	2.70	2.83	3.01	3.08	3.12
Motor Gasoline	14.92	16.23	17.69	18.96	19.74	20.35
Petrochemical Feedstocks	1.23	1.31	1.38	1.47	1.49	1.51
Residual Fuel	1.41	1.40	1.56	1.74	1.88	2.03
Other Petroleum	4.03	4.64	4.93	5.23	5.42	5.47
Petroleum Subtotal	34.06	37.84	41.17	44.37	46.36	47.84
Natural Gas	18.89	20.58	21.15	22.10	22.59	22.84
Metallurgical Coal	0.89	0.83	0.76	0.71	0.66	0.61
Steam Coal	1.73	1.70	1.84	1.92	1.92	1.94
Net Coal Coke Imports	0.03	0.03	0.05	0.06	0.07	0.08
Coal Subtotal	2.64	2.57	2.65	2.69	2.65	2.63
Renewable Energy	2.33	2.57	2.72	2.87	2.95	2.99
Methanol	0.00	0.00	0.00	0.00	0.00	0.00
Liquid Hydrogen	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	10.32	11.30	12.23	13.13	13.91	14.55
Delivered Energy	68.24	74.86	79.93	85.16	88.46	90.84
Electricity Related Losses	22.86	24.63	25.48	26.49	26.68	27.10
Total	91.1	99.5	105.4	111.6	115.1	117.9

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N A T I O N A L   E N E R G Y   M O D E L I N G   S Y S T E M

Table 2. Energy Consumption by Sector and Source (continued)

(Quadrillion Btu per Year, Unless Otherwise Noted)

Sector and Source	1995	2000	2005	2010	2015	2020
Electric Generators ...						
Distillate Fuel..............	0.13	0.07	0.06	0.06	0.06	0.07
Residual Fuel................	0.55	0.46	0.26	0.25	0.23	0.24
Petroleum Subtotal.........	0.68	0.53	0.32	0.32	0.29	0.30
Natural Gas..................	3.54	4.04	5.71	7.34	8.78	10.11
Steam Coal...................	17.31	19.43	20.27	21.02	21.87	22.60
Nuclear Power................	7.19	7.36	6.87	6.36	5.12	4.09
Renewable Energy	4.08	4.17	4.21	4.27	4.26	4.29
Electricity Imports	0.39	0.41	0.34	0.31	0.28	0.28
Total.....................	33.18	35.93	37.71	39.62	40.60	41.66
Total Energy Consumption						
Distillate Fuel..............	6.86	7.68	8.25	8.70	8.91	9.05
Kerosene.....................	0.11	0.12	0.12	0.12	0.12	0.12
Jet Fuel	3.13	3.84	4.47	5.22	5.79	6.28
Liquefied Petroleum Gas......	2.50	2.70	2.83	3.01	3.08	3.12
Motor Gasoline	14.92	16.23	17.69	18.96	19.74	20.35
Petrochemical Feedstocks.....	1.23	1.31	1.38	1.47	1.49	1.51
Residual Fuel................	1.96	1.86	1.82	1.99	2.11	2.26
Other Petroleum	4.03	4.64	4.93	5.23	5.42	5.47
Petroleum Subtotal.........	34.74	38.36	41.49	44.68	46.64	48.14
Natural Gas..................	22.42	24.62	26.86	29.45	31.37	32.94
Metallurgical Coal...........	0.89	0.83	0.76	0.71	0.66	0.61
Steam Coal...................	19.05	21.13	22.12	22.94	23.79	24.53
Net Coal Coke Imports........	0.03	0.03	0.05	0.06	0.07	0.08
Coal Subtotal.............	19.96	21.99	22.92	23.71	24.52	25.22
Nuclear Power................	7.19	7.36	6.87	6.36	5.12	4.09
Renewable Energy	6.41	6.74	6.93	7.14	7.20	7.27
Methanol	0.00	0.00	0.00	0.00	0.00	0.00
Liquid Hydrogen..............	0.00	0.00	0.00	0.00	0.00	0.00
Electricity Imports	0.39	0.41	0.34	0.31	0.28	0.28
Total.....................	91.1	99.5	105.4	111.6	115.1	117.9
Energy Use & Related Statistics						
Delivered Energy Use..........	68.24	74.86	79.93	85.16	88.46	90.84
Total Energy Use..............	91.1	99.5	105.4	111.6	115.1	117.9
Population (millions).........	263.6	275.6	287.1	298.9	311.2	323.5
US GDP (billion 1992 dollars).	6742	7654	8503	9433	10212	10899
Tot. Carbon Emis.(mill m. ton)	1411	1572	1683	1797	1880	1950

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